THE JOURNAL OF
# Engineering Education

November, 1952 Vol. 43, No. 3

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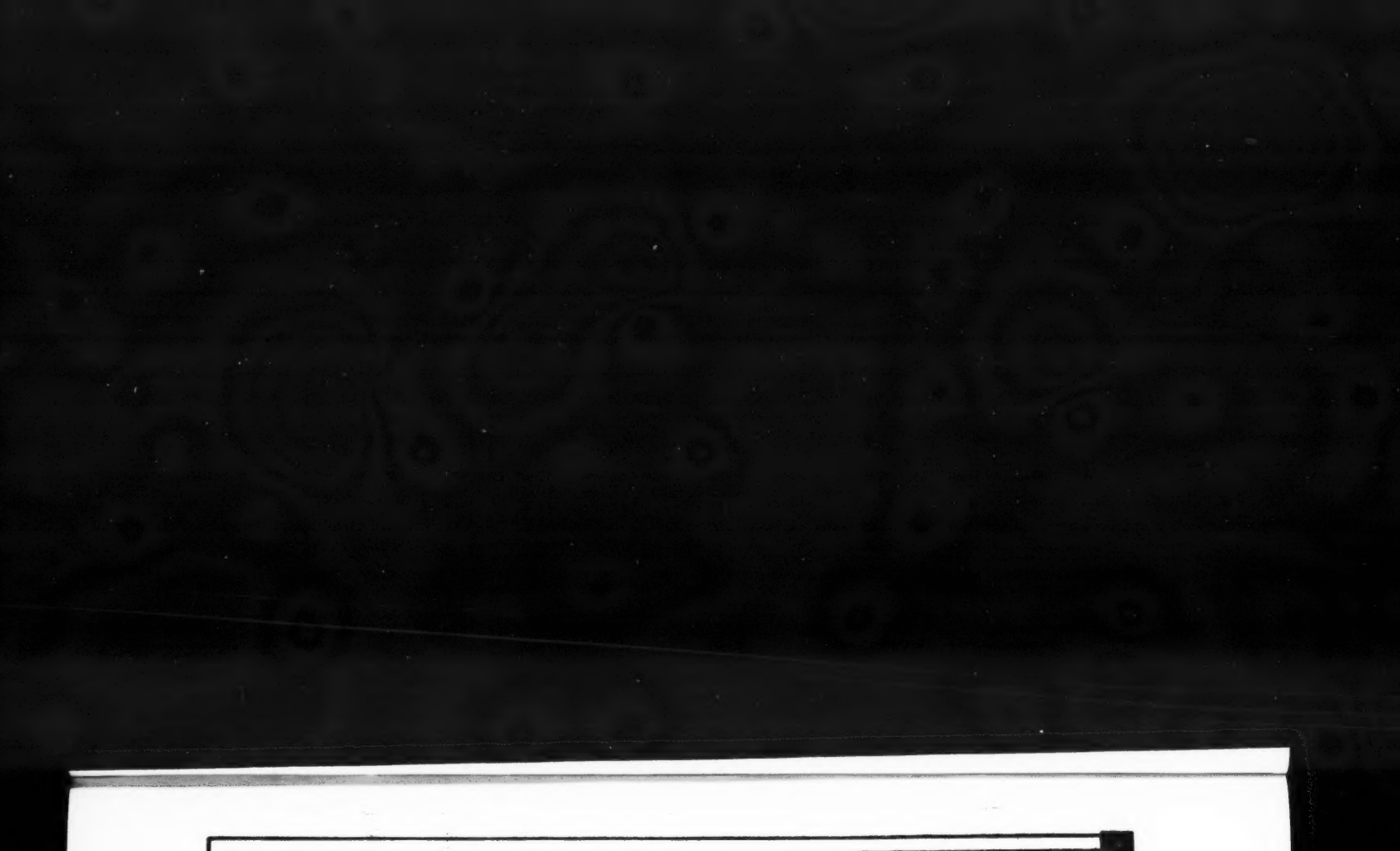

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ANNUAL MEETING—UNIVERSITY OF FLORIDA
Gainesville, Fla. June 22–26, 1953

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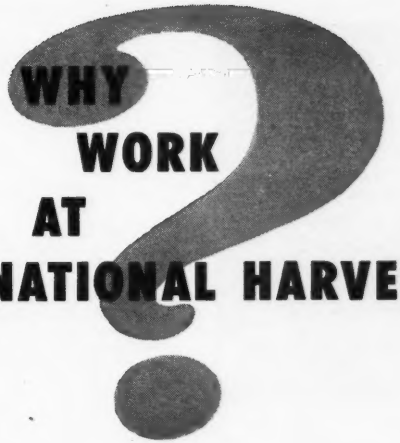
*Published monthly (except during July and August) at Prince and Lemon Sts., Lancaster, Pa., by the American Society for Engineering Education under the Supervision of the Publication Committee: A. B. Bronwell, Chairman, Northwestern University, W. R. Woolrich, S. C. Hollister, C. E. Watson, Editor. Entered as second class matter, October 17, 1912, at the Post Office at Lancaster, Pa., under the Act of August 12, 1912. Subscription Price, $5.00 per year; Single Copies, $1.00.*

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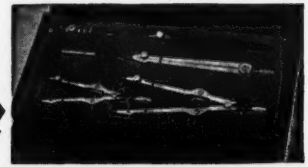

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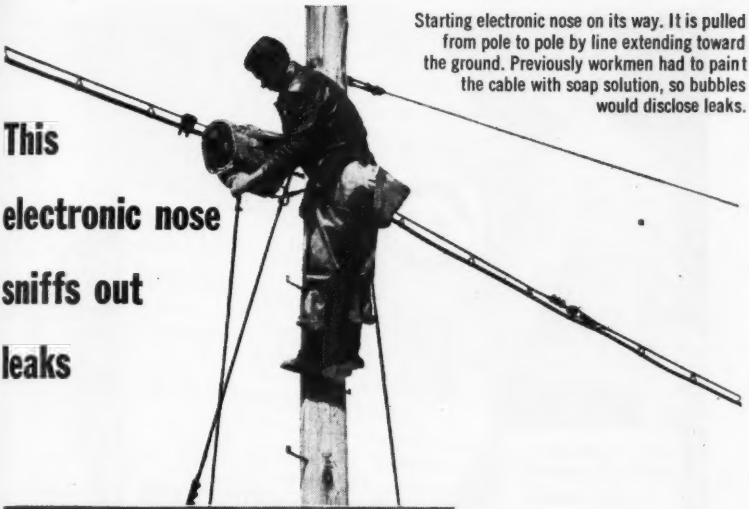
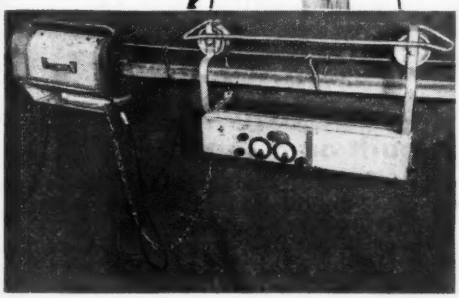


Starting electronic nose on its way. It is pulled from pole to pole by line extending toward the ground. Previously workmen had to paint the cable with soap solution, so bubbles would disclose leaks.



For test, the cable is cleared of protective nitrogen or air, and filled with Freon gas. Case at left collects escaping gas which operates Freon-sensitive detector underneath. At points where Freon escapes through sheath cracks, the box at right—a combined control unit and power supply—rings a bell. Workmen mark the point of leak for later repair.

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A Statement to the A.S.E.E.

on

# Youth and Engineering

By GENERAL DWIGHT D. EISENHOWER

The United States is facing critical times, and in the coming years we must make the best use of the vigor, enthusiasm, intelligence and technological skill of young people of this country.

It is true that Americans of an older generation may fix the line and set the goals for conduct of our affairs, but it is just as true that we must depend upon youth to provide the sinews that will carry us toward those goals.

I have spent much of my lifetime dealing with young Americans, and I feel that I know them well. I know particularly well the great initiative and good sense and courage they showed during the second World War. I know that they did not fail their responsibilities. I know the hopes and dreams they held—and still hold —for the future. I do not believe they have been dismayed despite the fact that, after their victory, others blundered or waivered and failed to make secure the peace for which they fought.

The young men and women of America know what they want for the future. They want peace with honor and the opportunity for initiative and self-reliance in the conduct of their own affairs. They want fair-minded and honest government of which they can be proud.

In this regard, our educational system has a greater and more pressing responsibility than ever before. It can encourage diligent awareness. It can arm us with the knowledge we need to protect our freedom and our economic well-being. Schools must fit our young people for the crises of our times or the freedom and opportunities of the schools will disappear in the ruin of all our free institutions. To this end academic freedom must be encouraged, and that means nothing more than specific application of the freedoms inherent in our way of life.

We Americans intend that our young people shall have full advantage of the benefits our country can offer; that they shall profit by our progress in education and health care. I am deeply concerned with the welfare of a free people and with the education and care of our children who one day must assume the responsibilities of preserving that freedom. We must work for the kind of country that will encourage and develop the capacity of parents to provide the care, the education, the religious background and the affection essential to full development of our children and our young people.

But that is not all. Far too many young people suffer deprivations as a result of inflation, high taxes, and maladministration of our affairs. We must reexamine our economic and social policies. In education we must remove hindrances to the exercise of parental responsibilities, and we must strengthen the effectiveness of community action where it is necessary to supplement home influence in the rearing of our youth.

The federal government has both negative and positive responsibility. So far as is possible it must leave the material resources of the country in the hands of the people or in the hands of state and local governments. But it must promote and encourage tested and successful methods of research and

education and health care—both public and voluntary—for the benefit of young Americans. Much of our public effort in this direction has been scattered or piece-meal or too far removed from an understanding of the family, the neighborhood, and the individual citizen. We must strengthen and coordinate these efforts. We must encourage the alleviation of the critical shortage of schools. We must provide better trained and better paid teachers. We must endeavor constantly to raise the standard of health among young people.

I want to do everything in my power to safeguard and improve the opportunity for young Americans. They must have the blessings of self-reliance and freedom. They must have, so far as it is within our power, the assurance of a secure and peaceful world.

The value of engineering and engineering education in securing this peaceful world cannot be overemphasized. The engineer has made many contributions in developing our national economy and our military preparedness program. In our highly complex technological society, the engineer is the creator of our modern tools of production. His efforts are largely responsible for America's great productive capacity and industrial superiority.

During the past World War, I saw engineers and scientists create instruments of warfare which gave our troops overwhelming military and strategic advantages. Their tremendous accomplishments in carrying on the research, design and production of such equipment as radar, the proximity fuse, the atomic bomb, and submarine detection, as well as developing superiority in airplanes, tanks, guns, and ships hastened the conclusion of the war and saved untold thousands of American lives.

Creative ability is one of America's greatest assets—one which we cannot afford to waste. Engineers, already in short supply, must make their contribution to the nation's welfare at their highest capacities where their special training can continue to accomplish miracles of production—our principal weapon in defending our society of free men.

*Reserve this date . . . .*

**June 22-26, 1953**

**ANNUAL MEETING**

**UNIVERSITY OF FLORIDA**

**GAINESVILLE, FLORIDA**

# Engineers*

By THE HONORABLE HERBERT HOOVER
*Ex-President of the United States*

I was once a non-resident engineering professor at Columbia University and gave a course of lectures that had all the wit of calculus, the humor of a trilobite and the joyousness of thermo-dynamics. Somebody remembered it about ten years later and paid me with an honorary degree. That entitles me to be on alumni lists for solicitation of funds.

Not all of you are engineers and thus some have not heard me declaim on that profession. This, then, is an opportunity not to be neglected even if I repeat a little.

Men never lose the love for the profession to which they have given years of their lives. The recollection of its joys is the more vivid if one has back-slid onto the slippery path of public life.

Within a little more than my lifetime, the training of engineers has risen from apprenticeship to a trade of secondary technical schools, to the dignity of a University-trained profession. It was the American Universities who pioneered the world in that breadth of training and endowed the profession with great dignity.

As indicative of the distance the engineers have risen in public repute, I might recall that some years ago while crossing the Atlantic I took my meals at the same table with a cultivated English lady. As we came into New York Harbor, at breakfast she said: "I hope you will forgive my dreadful curiosity, but I should like awfully to know what is your profession." I said that I was an engineer. Her involuntary exclamation was: "Why I thought you were a gentleman."

Even yet the scientists look down on the engineers as being something earthy or at least very subsidiary.

As a profession, engineering has both joys and sorrows.

The engineer has the fascination of watching a figment of his imagination emerge with the aid of science to a plan on paper. Then it moves to realization in cement, metal or energy. Then it brings new jobs and homes to men. Then it adds to the security and comfort of these homes. That is the engineer's high privilege among professions.

The profession, however, does have woes. His work is out in the open where all men can see it. If he makes a mistake, he cannot, like the doctor, bury it in a grave. He cannot, like the architect, obscure it by trees and ivy. He cannot, like the lawyers, blame it on the judge or jury. He cannot, like the politician, claim his constituents demanded it. Nor can he, like the public official, change the name of it and hope the voters will forget. Unlike the clergyman, he cannot blame it on the devil.

Worse still, if his works do not work he is damned. That is the phantasmagoria which haunts his nights and dogs his days. He goes to bed wondering where the bugs are which will inevitably appear to jolt its performance. He awakens at night in a cold sweat and puts something on paper that looks silly in the morning.

And the world mostly forgets the name of the engineer who did it. The credit goes to some fellow who used other people's money to pay for it. But the engineer, himself, looks back at the unending stream of goodness that flows from his

* Given at Columbia University, November 7, 1951.

successes with a satisfaction that few other professions can know.

Most people are not aware of it, but the engineer is also a political, economic as well as social force.

I asserted one time that he is the fellow who really dissolves monopolies, redistributes the wealth, and dismantles political platforms. Over our history, one generation after another, men have been elected to office by being sequently "agin" the monopoly of canals, or railroads or anthracite coal or kerosene oil or slums or private development of water power. There were no doubt great evils. But I ask you who really remedied these evils? It was the engineer. He upset the canal monopoly with the railways; he upset the railways with the automobile, the airplane and the pipeline. He upset the anthracite monopoly with coke; he upset the monopoly in kerosene oil with the electric light. He assured that most of the streams would remain as scenery by making cheaper power with steam. Who makes possible the escape from the slums? It is the engineer with his parkways, his bridges, his satellite towns. Who provided leisure for the housewife to play canasta and attend political meetings? It was the engineer with his household gadgets. Sometime the engineer will be needed to put truth into propaganda. But I am getting off the track of amiability.

I hardly need add that it was the engineer who distributes wealth by creation of mass production and his many other devices to reduce costs of production, and thereby brings the prices of a thousand gadgets to the level of everybody's pocketbook. Thus all men become equal before gadgets.

The training of engineers instills character in those who would join its ranks. High ethical standards are the essential of all professions, engineering included. Technology without intellectual honesty does not work. Construction without consciousness soon crumbles. Those are the reasons you have seen no engineers before the Kefauver Committee. Nor in the headlines which these days pour forth Grand Juries and District Attorneys' offices. In the main, engineers appear in public only to sit on juries.

And now after all this exposition surely you will agree that the engineer is an antidote to evil and the bearer of blessings. I hope you will also agree that he is worthy of your attention.

But here we meet a great national problem. We do not have enough engineering teachers and we do not have enough students to carry on the nation's work. And we do not have enough research facilities to assure the needed flow of new inventions and improvements.

One reason for this shortage is that a young mechanic with three years of training, during which he is paid, can earn more take-home pay after taxes than a young engineer with six years of training and three years more of experience. Too often the financing of such training is too expensive for his Dad. Could not more "somebodies" give more scholarships to needy boys who are willing to put in nine years with little reward?

The job of the engineer is to take the discoveries of pure science and convert them into use for the good of mankind. To this end he needs laboratories.

At one time we got our inventions from the genius in the garret. Poverty, however, does not clarify thought. Nor does it provide a laboratory. Bread and butter diet has been discarded as the mother of invention. Today these gifts come from long years of organized search and experiment. Therefrom, like the cell-by-cell growth of plants, fact builds upon fact until there comes forth the blossom of discovery, the illuminating hypotheses or the great generalization. And finally it finds fruition of a multitude of inventions and improvements in living. And it increases the power of a people to pay government debts.

This reminds me that there is one road to rapid recovery of the nation from our present burden of rearmament. That is

to increase our productive power by new technologies and new inventions.

And there are spiritual consequences of research. From them comes the unfolding of beauty, the ever-widening boundaries of thought. Here is the invocation of veracity in a world sodden with intellectual dishonesty. From its discoveries comes the lifting of men's minds beyond the depressing incidents of the day. Here is confirmation of a Supreme Guidance in the Universe far above man himself.

Today the nation needs more and more research and more and more engineers.

# College Notes

C. Fred Gurnham is the new head of the Department of Chemical Engineering at **Michigan State College.** His appointment was effective July 1. The 41-year-old chemical engineer has more than 20 years of experience in industrial and educational capacities. He came to M.S.C. from Tufts College, where he had headed the chemical engineering curriculum for four years.

**Cornell University** students will get some of their basic physics from the television screen beginning this fall. Plans to televise experiments in the freshman and sophomore physics courses were announced by Lloyd P. Smith, chairman of the Department of Physics. The main lecture room in Rockefeller Hall has been outfitted for the project, in which the Radio Corporation of America is cooperating. Experiments will be televised from the instructor's desk to viewing screens visible from all corners of the room.

Men and women engaged in the building industry, or preparing to enter the field in an administrative or supervisory capacity can now earn a college degree at **Columbia University** while mastering the principles of building construction. This double accomplishment is made possible by the establishment at the School of General Studies, the University's liberal arts undergraduate school for adults, of a major program in Construction Management. Upon completion of the 124-point curriculum, students receive the Bachelor of Science Degree. The Construction Management program calls upon the entire resources of the University. In addition to a minimum requirement of 64 points in cultural and academic courses that give the breadth of background desirable for further professional training, the course of study includes 60 points in professional and specialized courses given in the fields of architecture, engineering, business, and law.

The future bosses of business and industry have a "house to live in" this fall. A modern million dollar building has just been opened to students of the nation's first Graduate School of Industrial Administration at **Carnegie Institute of Technology.** Official dedication took place October 2 and 3. The School was founded January 17, 1949 with a six million dollar gift from the W. L. and May T. Mellon Foundation. One million dollars was designated for the new building and five million was established as the School's endowment.

# Minimum Mathematical Requirements for Engineering College Admission and Factors Which Affect This Problem*

## A Panel Discussion

By G. C. ERNST

*Professor of Civil Engineering, University of Nebraska*

### *Minimum Requirements*

The Society's published reports related to engineering college admission indicate that the minimum mathematical requirements have been scrutinized frequently over almost a century, although they have not changed materially during the past 40 to 50 years. During the later years, however, the factors affecting the problem have become increasingly complex.

The "Study of Engineering Education" reported by Dr. C. R. Mann in 1918 provided the following comparison of entrance requirements in mathematics, as typical of that period:

*Mass. Inst. of Tech.*

| 1870 | 1914 |
|---|---|
| Arithmetic | Algebra A—160 hrs. |
| Algebra to Quadratics | Algebra B—160 hrs. |
| | Plane Geom.—160 hrs. |
| | Solid Geom.—160 hrs. |

*Univ. of Illinois*

| 1870 | 1914 |
|---|---|
| Arithmetic | Algebra A—1 unit |
| Algebra to Quadratics | Algebra B—½ unit |
| | Plane Geom.—1 unit |
| | Solid and Spher. Geom.—½ unit |

The ever-increasing quantity of engineering knowledge in the various fields has created a desire by some to add plane trigonometry to the above list of entrance requirements, thereby permitting calculus to be taught preceding college physics and also allowing additional hours for engineering courses. Certainly, there has been no desire on the part of engineering colleges to reduce the mathematical requirements for admission, insofar as the published record of the Society's activities are concerned. However any detailed minimum requirements should be evaluated on the basis of engineering college need with due regard to the problems encountered by the secondary schools. As long ago as 1916 (SPEE *Proc.*, Vol. XXIV, p. 103) Dr. C. R. Mann in a Report of a Committee on Entrance Requirements stated ". . . An opportunity exists for the engineering school to bring about an improvement in the matter of entrance requirements by not demanding a unit of this or a unit of that, but by demanding certain abilities and by defining those abilities. . . . If you attack the problem from that point of view, you have a real contribution to make." This is as true today as it was 36 years ago, and is essentially the

* Presented at the Annual Meeting of A.S.E.E. at Dartmouth College, June, 1952.

approach taken by Ferguson, Henderson, Hoelsher, Meserve, Schmidt, and Dickman in their "Mathematical Needs of Prospective Students at the College of Engineering of the University of Illinois," published by the University of Illinois. This publication lists the minimum mathematical needs in very specific terms, with a total of 97 "indispensable topics, with an additional 13 topics recommended for study if time permits." It is interesting to note that the topics listed in 1911 for Algebra 1a, 2b, Plane and Solid Geometry, and Plane Trigonometry in the report on "Definition of Subjects Presented by the Committee on Entrance Requirements," SPEE *Proc.*, Vol. XIX, p. 336, correspond very closely to the 97 "indispensable topics" of the Illinois report of 1951 mentioned above. It seems certain that the mathematics teacher would have little difficulty in interpreting the two lists to be essentially the same.

It may be well to review the factors that have been found to affect the problem of mathematics entrance requirements. For convenience, they are divided into those of the secondary schools and those of the engineering school.

*Secondary School Problems*

A rather thorough discussion of the problems confronting the larger high schools is provided in "A Report on Mathematics Preparation for Engineering College" by Miller and Roth, ASEE *Proc.*, Vol. LIV, p. 628, 1947. In addition to the problems identified by Miller and Roth, many small high schools in the more sparsely populated areas are confronted with financial difficulties in providing mathematics instruction through trigonometry for the few students that might elect to take it.

Summing up the various problems evolving from the secondary schools, we have briefly:

1. A trend toward less mathematics combined with less emphasis on specific techniques, brought about by a growing belief that the prime function of a high school is to educate all youth and not merely to prepare a relatively small percentage for college.

2. Inability to obtain and hold good mathematics teachers at secondary school level.

3. Lack of practicability of separation of college preparatory students from others, let alone the separation of various college fields of study.

4. Inability to adequately finance mathematics instruction including trigonometry, on the part of the smaller schools.

*Engineering College Problems*

Although Engineering College problems have stemmed primarily from the growing volume of advanced technical developments that should be included in the 4-year curriculum, there has been a substantial number of the engineering teaching profession who have failed to understand completely either their own problems or those of the secondary schools. This lack of appreciation of the entire question may well be the major problem.

Stating them briefly, the problems are:

1. The proportion of the 4-year engineering curricula at present allocated to a specialized department of study (approximately 30% in the case of civil engineering, for example) is insufficient to cover the necessary quantity of engineering knowledge.

2. The need, on the part of engineering college faculties, to appreciate more fully the growing problems of the secondary school teachers in handling ever-increasing numbers of students, the majority of whom do not intend to enter college.

3. The need, on the part of the engineering college, to make secondary school students, advisers, and teachers continually aware of preparation needs for an engineering curricula.

4. There is a puzzlingly large number of engineering teachers who depreciate the usefulness of mathematics higher than trigonometry, with the erroneous viewpoint that calculus is a higher mathematics for those in research and investigation. It

is not very encouraging to note the recent publication of textbooks at the junior level, mechanics of material for example, in which the major advantage is preclaimed to be the use of no mathematics beyond plane trigonometry. Our editorial reviewers must have developed a rather short-sighted philosophy, and it seems that many engineering educators have need to readjust their sights.

*Closure*

In closing, it appears to the writer that it is extremely important to keep in mind that we are dealing with a situation calling for far more than a mere statement of minimum requirements and a strict adherence thereto. Every possible avenue should be made available to competent and interested students for entering on an engineering career whether or not the required units in specific mathematics courses have been acquired in the secondary schools. This does not mean that science or engineering courses could be taken before adequate preparation in mathematics but rather that the means to obtain the preparation must be made readily available and the competent student urged to complete it as soon as possible.

Furthermore a sounder understanding of the problems of the secondary schools seems in order, as well as a rather careful self-scrutiny as to our own actions in demonstrating the usefulness of all mathematics including the calculus.

By B. R. TEARE, JR.

*Dean of Graduate Studies, Carnegie Institute of Technology*

It is clear that the mathematics entrance requirement—making the proper joint between secondary school and college mathematics—poses an important question in engineering education. Mathematics, in addition to being a science of beauty and elegance in its own right, as well as a highly respected professional field, plays a most significant and almost unique role as a fundamental tool for the engineer. By means of it he thinks, and works, and learns, and moreover does these things with an otherwise unattainable precision and economy of effort. Almost all of the courses in the scientific technological part of our curriculum are learned more easily and more thoroughly if the student has an adequate command of mathematics before undertaking them. Consider, for example, the teaching of physics without making use of calculus. It can be done, but it proves to be most wasteful of effort compared with the teaching of physics after even a little understanding of derivatives and integrals. And the same is true of engineering courses. Thus it is desirable to have the student acquire an appropriately substantial background in mathematics as early as possible; the earlier the better from the standpoint of curriculum building.

The significance of mathematics in the admission of engineering students is shown by the great weight attached to the applicant's high school record in that field. He may stand high in a dozen different courses; but if he barely passes in mathematics, he is not a good risk for engineering.

Dean Everitt has precisely stated the problem we face, and I admire the direct and energetic approach that he and his associates have made to its solution, one that goes beyond the conventional requirements of four units of secondary school mathematics to a study and listing of topics that are useful to engineering students. Equally important in his approach is the cooperation that is being built up with secondary schools.

Moreover I am sure that something more than the specification of four units is needed if engineering freshmen are to begin with analytic geometry and do well in mathematics. At our institution we have had some experience that bears on this point. Some ninety per cent of our freshmen are admitted with four units, includ-

ing two of high school algebra and one-half of trigonometry, and for some years we have regularly and to good advantage excused the best of these students—about one-eight—from the normal first semester of mathematics, which is a review and extension of college algebra and trigonometry. Then, in an effort to move gradually toward a curriculum beginning with analytic geometry, we increased the number admitted directly to that course but found that the chief result was an increase in the number of students who performed poorly in mathematics. So we returned to our original procedure and tentatively decided that as far as our students and our particular course in analytic geometry are concerned, a conventional entrance requirement of four units does not by itself guarantee an adequate background for a curriculum beginning with analytic geometry. It may be that we shall find a satisfactory solution if we begin with a differently planned course in analytic geometry, one that allows time for a brief review of topics in algebra and trigonometry as and when they are needed.

Or it may be that our problem will be solved by thinking in terms of needed subject matter as Illinois does, and by joining with other engineering colleges in enlisting the cooperation of secondary schools. It is a fact that the Pittsburgh and Allegheny County Schools have shown a great willingness to be helpful.

It would be of interest to learn the experience of other institutions which for some years have successfully started with analytic geometry.

*Emphasis on Genuine Understanding*

Our experience also points to the need for another kind of emphasis in pre-college mathematics, beyond that on specific topics of subject matter. I mean an emphasis on genuine understanding, an understanding so thorough that the mathematics learned can be used in real situations, in situations new to the student, and in further learning. This level of understanding, even modestly interpreted, does not on the whole seem to be typical of entering freshmen. It is unfortunate that many high school students are more interested in passing an examination than in building a solid foundation for a professional career. Existing conditions were vividly described by the late, beloved Professor Hedrick in a talk on the same subject as ours this morning and given at the same kind of general session of an ASEE Meeting eleven years ago. He went on to urge that soft habits of thinking be discarded and that standards of performance be raised. I am sure that Doctor Hedricks's advice is still appropriate, and in view of the significance of mathematics in both education and professional work, its teaching for depth of understanding is essential and indeed is of even greater importance than coverage of subject matter. To be really useful to the professional engineer his secondary school mathematics must stay with him all his life, and on it is built not only his college education, but also the considerable learning that he achieves for himself after formal studies are ended.

The foregoing has stressed the need for sound secondary school education in mathematics, and, by implication at least, the need for equally sound mathematics in the engineering curriculum itself, and as early as possible. However we engineering teachers who urge our colleagues in mathematics at both college and secondary school levels to do a good job and to coordinate their activities for maximum performance must recognize that there is a reciprocal obligation on our part, that of making full use of the mathematics preparation in our own later courses. All too often engineering courses at junior and senior levels do not take full advantage of mathematics. I recall that one teacher, some years ago, prided himself on being able to teach alternating current circuit theory without using even calculus! And in other subjects teachers and texts frequently go to great lengths to avoid integrals by using average values which, to make matters worse, are not always clearly defined. Surely this is indefensible either as good education or in the light of what we are

trying to achieve in mathematics. If on the other hand, we use mathematics to the fullest extent, we not only strengthen our instruction, but also, because of improved efficiency, we may save some of the time we need so badly for other purposes in the curriculum.

*Coordination is Needed*

Let us consider some of the things that can be done to promote efficiency and optimum learning of mathematics. Coordination between courses is indicated, in fact several kinds of coordination. In the first place inadvertent duplication should be avoided, although it is clear that there is a place for planned and carefully handled repetition of subject matter. Timing should be arranged so that fundamental principles and techniques are learned before they are needed elsewhere. The content should be limited to what will be useful in later learning. More subtle and perhaps even more important is planning the character of instruction in mathematics with an eye to its future use in other courses and in post-college learning. And finally, something should be done to insure that mathematics will be used in other courses in such a way as to strengthen and deepen the understanding of basic content, and increase the capacity of the student to use fundamental principles and knowledge to go beyond existing practice.

These kinds of coordination are worked out at college level at Carnegie Tech by our Basic Course Committee on which all the departments concerned are represented. It has helped bring about close cooperation between mathematics and engineering departments, and has contributed significantly to the revision of our mathematics courses.

The cooperative development, as far as possible, of these same kinds of interrelationships between secondary school and college mathematics may help in solving the problem we are considering this morning. Indeed the activity that Dean Everitt has reported is a notable step forward, and I hope that this meeting and the discussion that it generates may point the way to further achievement.

By DR. ROGER B. SAYLOR

*Principal, Barringer High School, Newark, New Jersey*

I am quite certain that most of us are in agreement that every candidate for an engineering education should have credit for at least two years of algebra and it would be highly desirable to have taken advanced algebra too. He should have a year of plane geometry as well as a course in trigonometry and one in solid geometry. I am told that perhaps the solid geometry is the least valuable of all of these courses. I believe, however, that the course in solid geometry should enable the students to get a better concept of spatial relations. Even this gain in the spatial relations concept can be greatly improved by several courses in general shop work and in mechanical drawing.

It is most necessary that the secondary school pupils be not only exposed to these courses but that they gain a high degree of mastery. To gain this mastery they need to go far beyond the work in just mathematics. The command and the mastery of English is most important. Too often pupils fail to master problems not because of their inability to do the necessary mathematical work but because, through carelessness or lack of word understanding, they have not interpreted their problems correctly. It is most important that the students first determine the aim and objective of the problem presented and then organize the data carefully and systematically so that the logical solution will follow. I always remember the story of the father who took his son to hear a great man lecture. Upon returning home the father asked his son, "Son, how did you enjoy that great man's lecture?" The son replied, "Was he a great man? I could

understand every word he said." Definite understanding and interpretation is most important.

During the secondary school life of the student he or she has been under the careful counseling of trained guidance teachers. The pupils have been studied and helped in every possible way so as to develop their special talents and to give them many opportunities to be introduced to fields of work new to them. In the city of Newark, New Jersey, we no longer offer special courses such as the College Preparatory, the General, the Secretarial or other commonly named courses. We have adopted "Patterns of Study." Every pupil is given a pattern which we hope will meet his or her special needs in life. As the secondary pupils grow and develop they mature in many different ways. Some mature late and some mature early. In each case we try to meet the needs of these pupils. For those who mature early we attempt to enrich their programs so that they will be challenged educationally. Not infrequently you can find these pupils doing work which is of a calibre far beyond that expected of a high school pupil. We secondary school people believe that every child should be given the full opportunity to spend four years in a secondary school. We believe that those who do remain in high school for the four years enter college with a maturity which will enable them to grow rapidly in college. We realize the responsibility that this places upon the secondary schools. The great shortage of future engineers and the apparent failure of some secondary schools has prompted certain foundations to try to entice promising pupils to leave high school at the end of the sophomore year and enter college at that time.

If the present experiment of recruiting engineering students from the sophomores of high school continues then a great deal of the responsibility of the high schools will be transferred to the colleges. Up to the present time, I do not believe that the colleges have adequately prepared themselves for this responsibility. The transition from high school to college, from the home to the dormitory, from associates largely of their own age to older associates is a serious one. Our records show that many high school graduates with fine records frequently do quite poorly in college for the first term or possibly the first year. This is unfortunate for there should be a high correlation between the work of the freshman in college and the work he did in high school. For the student who finds himself early, there is a high correlation. I could cite definite instances of cases within the last year to prove my point. The matter was so serious that the head of my mathematics department checked very carefully with the head of the mathematics department of the college in question to try to solve the problem. In another case at a different engineering college, I wrote to the boy in question and was able to help him find himself so that now he is doing very good work.

Colleges today are realizing that the mere accumulation of facts and formulas is not as important as the ability to understand and apply the facts and formulas given to them. The interpretation of graphs and the summary of facts is most important. I believe the College Board is revising its tests along these lines.

There is another factor, too, which will be of great influence on the future engineering students. Th cost of living has advanced but the salaries of teachers has not kept pace with this advancement. Good science teachers can earn much higher salaries in industry than they can in teaching. In our own city we find it difficult to attract good science men to take our competitive examinations even though we probably pay the highest salaries in the United States for regular teachers. Industry will find it necessary to subsidize good teachers and good schools. I am pleased to say that there are signs of progress in this direction. More scholarships are being offered to promising young students and a number of companies are offering free summer work to mathematics teachers and to teachers of science so that they will be informed of the latest advancements in mathematics and in science.

Let us recognize the facts that the courses in mathematics presented as entrance credits are far from the answer to the problem of our panel discussion. Home background, influence of teachers, the type of community in which the child lives, and many other factors greatly influence the future of these pupils. Not long ago I heard Dr. Bowles of the College Board discuss the work of the Board. He told us how many of the potentially capable and "good engineering college risks" did not find their way to college. I have not lost faith. I am certain that if all of us work together with a mutual understanding of our problems we will continue to turn out "products" from our secondary schools and from our colleges who will keep pace with and go ahead of the needs of our industrial age.

By PAUL D. COLLIER

*Chief of the Bureau of Youth Services, State Department of Education, Hartford, Connecticut*

I will begin this discussion by raising a question. What should be the qualifications of students sought by Engineering Colleges? In the first place, they should have high scholastic aptitude as measured by standard tests. In the second place, they should have a broad basic general education. They should also have an advanced maturity of purpose developed through a thorough exploration of their interests and abilities. These students should have effective study habits enabling them to make the best possible use of their time and energy. It is highly important that they have physical stamina and emotional stability. These qualifications are necessary for success in other fields of study as well as engineering. In addition to the above qualifications, students seeking admission to Engineering Colleges should be able to present good records in those areas on the high school level known to be basic in the education of an engineer. There are several of these basic areas but the one under consideration is mathematics. While records must be good in terms of time spent and areas covered, should the College of Engineering require that a specific amount of time be spent and definite subjects be completed before the student may be admitted? Before answering this question, I wish to discuss another point.

If the prospective engineering student possesses the above qualifications, then in my opinion the following principle should be accepted and applied: "It is the responsibility of the receiving school or college to make the adjustment necessary to gear the student into a satisfactory, challenging, on-going program." This principle calls for a program tailored to the student's needs and abilities. This principle should apply wherever a learner is transferred from a lower to a higher school. This seems to be the best answer for the individual student.

### *Specialization*

It is now time to raise another difficult question. When should high school pupils begin their programs of specialization or majoring? Certainly, there is no particular grade where this should happen for all pupils. The emergence or development of dominant interests and purposes are determining factors. What is recommended for some pupils will not be satisfactory for others. Earmarking all or a majority of pupils at the beginning of the ninth grade for vocational or college preparation cannot be justified. This common administrative practice generally weakens a sound broad program of common learnings or general education needed by youth. Such a practice cannot be justified in the light of social and economic conditions. There is no need to speed up specialization except in unusual circumstances where pupils must prepare to earn a living at an early age. Even in these cases the manpower needs of the country would not be served through faulty or inadequate general and vocational education of early

school leavers. In forcing early beginnings of specialization or majoring, the period for exploration is shortened, resulting in less maturity for wise choices in the educational program. Counselors and advisors are forced to "box the compass" when the time for beginning specialization is fixed by administrative decree. Interests and motivation are dulled when early choices of program prove to be unsatisfactory. This results in pupils not working up to capacity which encourages the development of time-wasting habits. If colleges insist on set patterns of preparation, they may be unwittingly prolonging the shortcomings resulting from beginning specialization too early.

One of the greatest barriers to functional education on the high school level is the fear of college entrance requirements. Let me define what I mean by functional education. Functional education must be designed for use here and now. It must prepare the learners to face inescapable responsibilities in life as workers, citizens and home members. It must help them solve their personal problems as well as the real problems facing the society in which they live.

A functional program of education is difficult to achieve unless the curriculum organization permits and encourages the problem approach, the unified subject approach to some extent and some pupil participation in planning. I am convinced that the colleges should encourage the development of functional programs in the secondary schools. I believe those students who have a more functional education in the secondary school will be more self-directive and more mature to do college work.

Some of the most promising improvements in education are coming as a result of increased understanding of the learning process and more effective instructional procedures. We should avoid cramping the development of the "American Process" in education by insisting on instructional approaches and curriculum organization which are too formal, in fact outmoded

With the above background, I will now give attention to the field of mathematics. We scare pupils with subjects in mathematics that follow arithmetic on the high school level. Actually, we ought to emphasize the similarities, the kinship of arithmetic to all other subjects in mathematics offered in the high school. We should carefully identify and analyze the competencies of pupils in mathematics as they move from a lower to a higher school and as they approach the time for selecting a new subject in mathematics for study. Necessary adjustments should be made, involving review and tying in the new subject with work previously covered. Mastery and memory are aided in applying mathematics in solving practical problems.

All fields of endeavor, which apply mathematics should contribute real problems to be used in the high school program. Can engineering be a more fruitful source in the future, and contribute real practical problems? Textbooks and curriculum guides are recognizing applications in a great variety of situations, but much remains to be done before a truly functional program is adopted. Again, it should be emphasized that time would be saved through aids to mastery and memory if a more functional program were adopted. Engineering, undoubtedly, has a tremendous contribution to make in this respect. Problems submitted would affect the teaching of all the mathematics that can be offered at the high school level.

### *Time Factor*

The secondary school program is crowded. New demands for time allotments are constantly being reviewed by principals and faculties. One of the most difficult issues faced today concerns the allotment of time to the growing number of curricular and extra-class activities which are being scheduled in the secondary school Allotments of time should be determined on the basis of relative values within the purposes of the school. Since there is keen competition for time, the effective use of time is paramount. Time-serving rather than attaining competency too often seems to be a major goal. The

Carnegie Unit which requires time serving holds the secondary school schedule in a straight jacket. In mathematics generally required for admission to engineering one period for each of 720 days is at present required. Experiments have shown this to be a waste of time. In two Connecticut schools, it has been easily possible for good mathematics pupils to complete first-year algebra in ninety days. Time undoubtedly could be shortened in algebra II, plane geometry, solid geometry and trigonometry for capable pupils. Probably the four years mathematics could be completed in fifty per cent of the time now used. This possibility has many implications.

With a realistic appraisal of the potentialities of capable students of mathematics in high school, many statements commonly accepted should be challenged. For example, the following statement is not true: "Unless a pupil takes mathematics in the ninth and tenth grades, he cannot qualify for admission to a college of engineering." Capable pupils can do more and in less time in the field of mathematics than is now considered possible. It is also assumed that it will take more than four years to graduate students from an Engineering College, who offer less than the usual four years of high school mathematics for admission. This would seem false to me owing to reasons already stated. Time serving may be traditional at the college level also and without valid justification. The fact that gifted and near-gifted youth are not being adequately challenged in secondary school is well known. It is also probably true that they are not being adequately challenged in college.

To solve the problem of establishing competence to begin to learn engineering, by standardizing the time and subjects required, seems unworthy of intelligent professional people. However, this type of thinking and action dominates the senior high school schedule. It also controls the ninth grade in the junior high school. Experimentation is necessary on the local level to convince many principals and teachers that the Carnegie Unit is blocking some of the better developments in curriculum improvement and administration of the secondary school.

### *Conclusion*

In summary, I would like to make the following statements for your consideration:

1. The qualities of high intelligence, advanced maturity, definiteness of purpose, effective study habits, physical stamina and emotional stability are necessary for success in college.

2. Prospective engineering students must make good records in mathematics on the high school level in proportion to the time spent in this field.

3. If a student possesses marked potentialities for engineering, it is the responsibility of the college which accepts him, to tailor his program to mesh with his previous preparation in mathematics.

4. Earmarking pupils for beginning specialization or majoring on the ninth grade level should not be the result of administrative decree, or control of subject patterns by higher institutions of learning.

5. A balanced program, including both common learnings and specialization, should be developed for each pupil on the high school level.

6. The fear of college entrance requirements set up in terms of Carnegie Units is delaying the development of functional education in the secondary school.

7. Mastery and memory in mathematics increase as the curriculum in this area becomes more functional.

8. The present time allotments required in the field of mathematics on the secondary school level are wasteful and do not sufficiently recognize or challenge the abilities and interests of the pupil.

9. Required mathematics on the high school level serves two major purposes; first to aid pupils in solving practical problems of living and second to help determine their potentialities for developing mathematics as a tool in higher education.

10. Engineering colleges should consider entrance requirements in mathematics in terms of competencies for time spent as an alternate for requiring specific Carnegie Units.

# The Role of Sponsored Research in Training Research Personnel*

By RALPH A. MORGEN

*Program Director for Engineering, National Science Foundation*

If there is one point that appears clear in the report of the Industrial Research Institute survey it is that there is no unanimity of opinion. On the other hand there are some general trends and opinions which seem to be favored by the great majority of those who answered the questionnaire.

This discussion is to cover the topic of "The Role of Sponsored Research in Training Research Personnel." The answers to the questionnaire on the subject of "University Connected Research Institutes" showed a sharp division of opinion as to whether or not such institutes were desirable. Since most of the institutions which have affiliated research institutes conduct their sponsored research through those institutes it is appropriate to assume that there would be a similar divided opinion on the whole subject of sponsored research.

It is therefore pertinent to this discussion to review very briefly what it is that an engineering college connected with a university attempts to do.

1. There is unanimous opinion that each university should have the best possible undergraduate curricula in the various engineering areas in which it is interested. In order to maintain this high level undergraduate teaching program the university must employ competent teachers and provide an environment that will encourage them to maintain this level. This implies that the staff will have time for professional development in addition to the teaching of undergraduate courses. Professional development might include activities, such as (a) academic research, (b) industrial consulting work, or (c) industrial employment during summers and on sabbatical leaves.

2. A second function of the engineering college of a university, in addition to the teaching of undergraduate curricula, is to extend the frontiers of knowledge through research. This function implies that at least a portion of the regular staff must have the desire, time and funds to conduct engineering research.

3. A third and increasingly important function of an engineering college of a university is the development of a graduate program for the training of students beyond the baccalaureate degree. It would appear that in engineering and the other physical sciences the nation needs about twenty persons trained at the masters level and about five persons trained at the doctoral level for every one hundred trained at the baccalaureate level. As the complexity of the technological world increases it is quite probable that the percentage of advance degree persons needed will increase compared to the need for first degree level engineers. Dean Hollister, President of the American Society for Engineering Education, has pointed out consistently during the past year that the bottom of the manpower barrel is being scraped for prospective engineering stu-

* Presented before the E.C.R.C. June 21, 1952.

The statements are those of the author and do not necessarily represent the policy of the National Science Foundation.

dents. Therefore, it is going to become increasingly important that engineers are educated to the highest possible level. More graduate work is needed to achieve this objective.

4. A fourth obligation of an engineering college connected with a university is to conduct some developmental research with particular reference to the resources of the area in which the university is located and toward the well-being of those industries which exist in the university's immediate area. This is particularly true of those institutions which have received appropriations for an engineering experiment station.

In addition government-sponsored research in the interest of national defense should be undertaken for the benefit of the nation as a whole. Each institution must decide for itself how much of this kind of work it should do depending on the availability of staff and facilities.

It is obvious, therefore, that an engineering college should conduct two types of research; one which shall be called "fundamental" simply for want of a better word, and the other shall be called "developmental," again for the sake of lack of a better word. In many cases the "developmental" type of research might be called basic research by one group and not be considered basic by another. By the the same tenets some of the "fundamental" research might not be considered really basic research by one group or another.

For the sake of this discussion the "fundamental" research shall be considered dimensionless as far as *time* and *economics* are concerned. In other words, it will be a research problem to advance the field of knowledge in which the research worker happens to be interested and which has no direct objective as to when the work must be completed, nor as to whether or not the end of the work will result in an economically sound process, product or machine. Since fostering this type of research is one of the prime obligations of a university, funds must be obtained for this type of research from one or more of several sources. Certainly a portion of the research of this type should be supported by the university out of its own regular funds as part of its ordinary functions. Gifts, grants, and donations from various private sources can be expected to supplement funds needed to support this type of research. The National Science Foundation is the agency of the Federal Government which is specifically empowered to encourage and finance this kind of "fundamental" research.

However, it is clear that if an engineering college is to discharge its functions properly it must conduct some "developmental" research which, for the purposes of this discussion, will be distinguished from the "fundamental" program by the fact that the dimensions of *time* and *dollars* will be an integral part of the program. Since engineering per se is the application of scientific knowledge to the use of man, it is obvious that that application must be done in a reasonable length of time and at a price which a sufficient number of people can afford to pay in order to make the product, process or whatever it is, worth producing.

It is obviously to the advantage of the engineering students to have both types of research in operation at the same institution so that the students may become familiar with and have the opportunity to become proficient in the two types of research. It is not necessarily assumed that the same student will conduct research in both areas during his graduate program but he will have the opportunity to at least choose between them. Whichever program he chooses to follow for his own work he will have some acquaintanceship with the other program through association. The "developmental" type of research should not be done with the university's regular educational fund but rather through contract with agencies which desire to have the work done for a specific purpose (or through engineering experimentation station funds). Those

agencies might be industrial concerns with a specific problem in mind for which a solution is desired or they might be federal agencies, such as the Department of Defense, with specific end-aim objectives in sight. In each case the factor of *time* and *dollars* would *be* an integral part of the program.

There are some who would say that this latter type of program should not be done on a university campus. Exception is taken to that point of view as long as the developmental program continues side by side and complimentary to the fundamental program and not in lieu of it.

This type program is defined for the purposes of this discussion as "sponsored research." For this type of research there are four very distinct advantages on the credit side of the ledger, both for the members of the staff engaged in the program and for the graduate students who are associated with the program. (Parenthetically it should be said that very often research of this type is not satisfactory for graduate students to conduct for thesis purposes but does supply a source of income which makes it possible for the graduate student to remain in school.) These advantages are:

1. REPORTS are an integral part of any "sponsored" research program. There is no better training ground for the writing of clear, concise, engineering reports than to engage in a reseach and development program which requires the personnel to write the results of the experimental program. The report must be written in such form that it will be useful both to the technical personnel and to top management who might not be technically trained.

2. A sponsored research program usually specifies a specific TIME at which certain definite objectives must be achieved. While this sort of time factor often affects adversely certain types of fundamental research the experience of meeting a deadline is a very good one for a graduate student to achieve early in his career.

3. The industrial sponsor of a research program usually has a DOLLAR and CENTS ultimate objective. In the truly fundamental program the kind of material used, the life of the mechanism, the number of man hours involved in production are considered only minor factors if consideration is given to them at all, whereas in the sponsored program these factors often become the dominant or controlling factors. An appreciation of the dollar valne of a research program is a very important consideration in the training of graduate students as well as achieving the objective of the sponsored research program.

4. The discipline of working for a specific goal where the "END–AIM" of a research program is established before the work is started is another most important lesson for a graduate student to learn. This lesson can be applied well in a sponsored research program.

At the same time that these advantages are being discussed certain inherent disadvantages in a sponsored research program must not be overlooked. Some of the disadvantages that have been mentioned are:

1. There is a danger that the staff and the graduate students might slight the more basic and more fundamental research programs in favor of the developmental type of program.

2. There is a similar danger that a university will take on a sponsored research program as an overload for the staff and thereby decrease the efficiency of both the sponsored research program and the regular academic program.

3. There is the ever-present danger that a sponsored research program will tend to bring the factory atmosphere into the university, with a consequent loss to the academic atmosphere. A judicious compromise is hard to maintain. It would appear, therefore, that there are four very important reasons why sponsored research should be part of an engineering college program. On the other hand, there are several dangers and disadvantages to such

a program on a college campus. It is believed that the advantages far outweigh the disadvantages and that a properly enlightened university administration can prevent the disadvantages from becoming dominant.

It is agreed by all that a fundamental research program on the college campus is essential for the long term well-being of this country. It is agreed by all that the engineering colleges must participate in this long range fundamental research program. On the other hand, it is also important that the graduate students become aware of the *time* factor and the *economic* factors involved in industrial research programs. This result can be achieved by the proper ratio of sponsored research to academic research.


## Now Available . . .

Reprints of the **Report of the Committee on Improvement of Teaching** which appeared in the September, 1952 Journal of Engineering Education. Checks and orders should be sent to the Journal of Engineering Education, Northwestern University, Evanston, Illinois. The price is 10¢ per copy in quantities under 100, 05¢ per copy in quantities over 100.

# Report of Committee on Atomic Energy Education

The Committee on Atomic Energy Education of the American Society for Engineering Education was appointed in the spring of 1950 by Dean Thorndike Saville, at that time President of the Society. The original committee was composed of the Chairman and Secretary and five members chosen from a list of candidates submitted by officials of the Atomic Energy Commission at each of its major installations. The Atomic Energy Commission at the same time designated one of its staff members at each major installation to be an AEC representative for the region and to cooperate with the local member of the ASEE Committee and with the subcommittees, which were to be appointed by these members from staffs of engineering colleges in their region. The original Committee was composed of the following:

Dean Robert C. Ernst, University of Louisville
Dean Ovid W. Eshbach, Northwestern University
Professor Henry B. Hansteen, College of the City of New York
Dean Morrough P. O'Brien, University of California
Dean Harold E. Wessman, University of Washington
Henry H. Armsby, U. S. Office of Education, Chairman
Dr. Philip N. Powers, Atomic Energy Commission, Secretary

The only change in the personnel of this Committee has been the replacement of Dr. Powers as Secretary by Dr. Alberto Thompson of the headquarters staff of AEC.

At the first meeting of the Committee in June 1950, it was decided that the program could be most effectively conducted through regional subcommittees to be appointed by each of the five members of the main Committee. The Committee outlined the following five objectives to be sought through the cooperation of the regional subcommittees with AEC and its contractors:

(1) To evaluate the responsibilities of engineering education in aiding the growth and development of the atomic energy industry and to determine what there is in the development of nuclear engineering which can be used to enrich and strengthen engineering education.
(2) To assess the over-all needs for engineers with special training in nuclear energy.
(3) To explore with AEC and its contractors subjects or fields for research which may be carried out by graduate students or engineering faculties.
(4) To define the needs of educational institutions with respect to instructional materials (a) for the modification of existing courses in basic sicence and engineering, (b) for the modification of standard engineering curricula, and (c) for advanced training of engineers planning to specialize in nuclear energy.
(5) To formulate plans for facilitating the flow of needed information regarding such instructional materials to the engineering schools.

The subcommittees have been appointed and have been active, having held a number of regional Conferences. The main Committee has held two meetings subsequent to its first one, and has maintained

close liaison with AEC officials, and through the subcommittee members with the institutions. At least three developments of general interest to the Society have grown out of the activities of the main Committee:

(1) the bibliography "Nuclear Science in Engineering Education," which was prepared and published by AEC in accordance with suggestions made by the Committee,

(2) the highly successful summer symposium which was held at Oak Ridge last summer by the Oak Ridge National Laboratory and the Oak Ridge Institute of Nuclear Studies and sponsored by ASEE through this Committee, and

(3) the "Sourcebook on Nuclear Engineering," suggested by our Committee, which has been approved by the Atomic Energy Commission and will be written by Dr. Glasstone, the Editor of the famous "Sourcebook on Atomic Energy."

At the Dartmouth meeting of ASEE in June 1952 the Committee sponsored a program which was attended by approximately one hundred and sixty persons, who evidenced great interest in the program. The program consisted of (1) a report from the secretary of the Committee on the April meeting of the steering Committee, (2) a paper by Dean Ernst, discussing and listing the engineering courses bearing applications of nuclear energy which are being conducted in engineering colleges, (3) a paper by D. W. McLenegen of the General Electric Company under the title "The Education of Nuclear Engineers as Seen by an AEC Contractor," and (4) an informal discussion conducted by Dr. Keith Glennan, U. S. Atomic Energy Commissioner, in which he presented informally the more significant parts of the staff paper prepared by the AEC technical staff for the use of the Commission in formulating a policy with respect to supplying nuclear reactors for engineering colleges. Commissioner Glennan asked the audience to consider themselves as temporary members of the Commission and to express to him their opinion as to a desirable policy for the Commission to adopt. The discussion following this presentation was very active and the "temporary Commissioners" made recommendations to Commissioner Glennan which he undertook to transmit to the Commission for its consideration.

Copies of the papers by Dean Ernst and Mr. McLenegen will be sent to all Deans of Engineering Schools and to all members of the ASEE subcommittees.

The Committee recommends to the officers of the Society that the Committee be continued, but with a rotation of members and chairman.

HENRY H. ARMSBY, *Chairman*

# Lamme Award

The Committee on Lamme Award is always anxious to get nominations for the Award from the membership of the Society. Any member may place a name in nomination; the selection will be made by the Committee by letter ballot.

The Lamme Award consists of a gold medal and bronze replica bestowed annually upon a distinguished engineering educator for excellence in teaching and contributions to the art of teaching; contributions to research and technical literature; achievements which contribute to the advancement of the profession; and engineering administration. The Lamme trust fund was established in memory of Benjamin Garver Lamme.

Until January 15, 1953, the Chairman will receive formal nominations from members of the Society. It is very desirable that nominations be accompanied by a brief statement made according to the outline suggested below.

A number of years ago the Committee set up the following rules for making the Award:

1. Achievements which can be taken as proof of excellence in teaching or as having contributed to the art of technical training will be given major consideration.

2. Only those achievements will be considered which seem to have the possibility of lasting influence or which have sufficiently stood the test of time.

3. Books, articles, contributions to method and research, which have a beneficial effect upon the teaching of engineering, will be given considerable weight in making the decision.

4. Participation in the work of Engineering and Educational Societies is not necessary for eligibility. Such participation, however, will be given due consideration if it has led to definite and recognized results in bettering technical education.

5. Achievements outside of the field of teaching, such as employment in industry, consulting work, inventions, etc., will be considered as of secondary importance in making the Award.

6. Administrators in engineering schools are eligible. Only that work of Administrators, however, will be considered which has led to definite and recognized improvements in method of teaching or in the art of technical training.

7. Emeritus Professors are eligible.

8. Nominations should emphasize the contributions of the candidate to these major objectives Concise statements of achievements are much more valuable to the Committee than a series of recommendations from former students and present acquaintances. Listings in "Who's Who in Engineering," and such publications, give some information regarding achievements but material of this type will not give the Committee the needed information to make a valid judgment.

In preparing a biography of a nominee the following outline should be helpful:

1. Preparation for teaching work—school year graduated, degree, post-graduate work, honorary degrees.

2. Accomplishments as a teacher.

3. Advancement of the art of technical training—books, articles, contributions to method, research, etc.

4. Administrative work in engineering schools.

5. Membership and participation in Engineering and Educational Societies.

6. Engineering practice—employment in industry, consulting work, inventions, etc.

7. Other achievements.

Nominations should be sent to the Chairman of the Committee, Dean F. E. Terman, College of Engineering, Stanford University, Stanford, California by January 15, 1953.

# The George Westinghouse Award

The George Westinghouse Award is an annual award established in 1946 by the Westinghouse Educational Foundation to recognize and encourage outstanding achievement in the teaching of students of engineering. The award consists of $1000, together with an engraved certificate. The recipient is selected by a ten-man committee, each member of the Committee serving for a term of four years. There is also a representative from the Foundation. The Award for 1953 will be presented at the banquet of the annual convention at University of Florida, Gainesville, Fla., June 22–26, 1953.

The recipient of the Award must have made a significant contribution to the teaching of engineering students and shall have distinguished himself in several of the following ways:

1. Record as a teacher. (Evidence of superior teaching and guidance of students as demonstrated by records of former students, indications of unusual subject matter competence, etc.)
2. Improvements of the tools of teaching. (Textbooks and student notes, descriptions of special courses or curricula, diagrams and models, new laboratory and teaching equipment, etc.)
3. Other activities contributing to the improvement of teaching. (Material relating to the development of teachers in the nominee's department or teachers in general, the development of testing and guidance program for students, the promotion of cooperation with other types of educational units or with industry, coordination of fields of subject matter, etc.)
4. Evidence of high intellectual capacity. (Brilliance of mind as manifested by contributions to literature, degrees and honors received, etc.)

The Award has been established to encourage younger men who have shown by their past record evidence of continuing activity as superior teachers. To them the Award may serve not only as a reward but as an incentive toward further achievement.

In order to achieve this intent, it is deemed essential to limit the Award to those who have not reached the age of 45 by the date of the annual presentation.

Nominations may be made by any person, organization, or group and are to be submitted before January 15, 1953, to the Chairman of the Committee on Award, Professor F. B. Seely, Professor of Applied Mechanics Emeritus, 120 Talbot Laboratory, University of Illinois, Urbana, Illinois. Nominations must be made on forms available from either the chairman of the Committee or from the Secretary of the Society. Nominations should be accompanied by significant evidence supporting statements and claims.

# Government-Supported Research*

By DR. ALAN T. WATERMAN
*Director, National Science Foundation*

I welcome this opportunity to meet with the Southeastern Section of the American Society for Engineering Education at its annual meeting. I have been invited to address the meeting this afternoon on the general subject of Government support of research. However, the extent and diversity of Government support of research and development are now such that it would probably be more meaningful if I were to approach the subject from the viewpoint of the National Science Foundation, which has just marked the end of its first year of operation.

The Foundation has a three-fold mission: the development of a national science policy; the support of basic research through grants, contracts, and other forms of assistance; and the furtherance of education in the sciences through the award of fellowships in the natural sciences, and through other means designed to strengthen and encourage education in the sciences. The establishment of the Foundation by the National Science Foundation Act of 1950 occurred at a critical time in terms of the national need. Although Government expenditures for research and development are at an all-time high, all but a relatively small portion of the total is being spent for applied research and development vital to the national defense. In 1941, the estimated total research and development expenditures in the United States were $800,000,000 of which the Government spent $240,000,000, or approximately 30 per cent. In 1952, the total national expenditure for research and development is estimated at $2,930,000,000, of which the Government is spending $1,640,000,000, or 56 per cent of the national total. In 1952, industry is spending an estimated total of $1,190,000,000 on research and development, or 41 per cent of the national total; while the universities are spending only $100,000,000, or about three per cent of the national total.

The work that is going on in the universities, though much smaller by dollar volume than either Government research or industrial research, is nevertheless a highly important part of the over-all effort, for it includes a substantial portion of the basic research being supported in this country, and without basic research both applied research and technology would ultimately come to a halt.

The National Science Foundation is operating on a very small appropriation, only $3,500,000 for fiscal 1952. The outlook for additional funds in 1953 depends upon action by the Senate Appropriations Commitee and subsequent action by the House and Senate. Approximately 40 per cent of this amount is being spent in support of basic research in the universities, and a similar amount for predoctoral and postdoctoral graduate fellowships in the natural sciences.

We regard the graduate fellowship program as of special importance at the present time because of the critical shortages of trained personnel in many of the natural sciences, and particularly in engineering. Another highly significant aspect of the scientific manpower problem is the need that has just begun to emerge for special combinations of training, par-

* Abstract of remarks made at Southeastern Section Meeting, Clemson College, April 10, 1952.

ticularly among the fundamental physical sciences and various branches of engineering. For example, the electronics engineer has sprung up as a hybrid between the physicist and the electrical engineer. The atomic energy program has resulted in the need for combined engineers, nuclear physicists, and chemists. Another important need is for chemists and for solid-state physicists for problems in materials and some forms of construction engineering.

With scarcely a year in which to operate —1952 funds became available only in November of last year—the Foundation has not had time to gather all the data needed for a full assessment of the Nation's scientific needs. The gathering of such data is preliminary to the development of a national science policy. The Foundation feels that the Nation's scientists and engineers are the persons best qualified to assist in the assessment of national need. Accordingly, we are calling upon scientists and engineers from all parts of the country to assist us as consultants and advisers in the gradual development of an over-all picture of the national needs in science.

It is a matter of special gratification and interest that the South is contributing more and more of its great natural resources, both human and material, to a variety of research and development activities. The South is particularly to be congratulated upon its awareness of these problems and for the positive steps it is taking to solve them. It is important to the Nation to be able to look to the South for important new contributions in the field of research and education in the sciences.

*Reserve this date . . . .*

**June 22-26, 1953**

ANNUAL MEETING

**UNIVERSITY OF FLORIDA**

**GAINESVILLE, FLORIDA**

# Teaching with Color*

By WILLIAM C. KRATHWOHL

*Director of Tests, Institute for Psychological Services, Illinois Institute of Technology*

Color can be so useful in effective teaching that it is a wonder it has been used so seldom. Although it has exceptional usefulness in mathematics, many of its applications, with a little ingenuity, can be transferred to other subjects.

Some of the uses of color are for clarity, emphasis, analysis, economy of effort, and interest. Often these uses overlap. An instructor who has not used colors in the classroom cannot realize how many opportunities he has missed, where, by means of colored chalk, he might have stressed a point more emphatically or cleared up a statement more effectively.

Color is not only applicable to drawing pictures in geometry but it can also be used in such subjects as engineering, technical drawing, arithmetic, algebra, English, the physical, biological and social sciences and the humanities.

### *Clearness*

As an illustration of the use of color to promote clearness, consider a problem involving the operations of addition and subtraction in algebra such as:

$$3a - 2b - 5c + 6b - 2a + c = a + 4b - 4c.$$

If pink is used wherever $a$ occurs, green with $b$ and blue with $c$, and if the two sides of the equation are compared, it does not take much imagination to see how the pink quantities on the left give the pink quantity on the right, the green quantities on the left give the green quantity on the right, and the blue quantities on the left give the blue quantity on the right. If it becomes awkward to write the quantities in colors, good effects can still be obtained by writing the equation in white chalk and then using colored chalk to check off or encircle similar quantities. To see the same thing with the equation written in black and white, as is done on this page, requires, even in such a simple case, a certain amount of searching.

Frequently verbal problems can be simplified by using colors. Take the problem of a rectangle with changing sides. Here, the original rectangle can be drawn in black and white, whereas the changed rectangle can be drawn in colors.

Mathematicians and engineers often have to draw pictures and even though they may not be rated as artists, color can compensate for their artistic deficiencies. For an example, consider the complicated figure which arises in the computation of a volume by means of triple integrals. If rectangular coordinates are used, it is necessary to slice the volume into slabs, the slabs into columns and the columns into rectangular parallelepipeds. If a rectangular parallelepiped is drawn in yellow, a column in red, a slab in blue and the volume itself in green, the student can easily see how to go from one type of volume to another without a lengthy explanation.

As another illustration consider the case where there may be two triangles which have to be pointed out in a complicated figure. Instead of talking about the triangle ABC and the triangle DEF, if the instructor talks about the red and yellow triangles, the student is able to see these at once. Otherwise he hunts around try-

* Presented before the Mathematics Division at the Annual Meeting of the ASEE, Dartmouth College, June, 1952.

ing to find where A is, then where B is and then where C is. Often by the time he has found B and C, he discovers that he has lost A and has to start all over again. Add to these troubles, his difficulties in finding D, E and F, and it is no wonder that confusion becomes worse confounded. To say that using colors instead of letters is an economy of effort is putting it very mildly.

Another instance occurs not only in geometry but also in trigonometry, where it is necessary to associate an angle with a side. Here the angle can be shaded in the same color as that in which the opposite side is drawn.

Solid geometry lends itself particularly well to color in such complicated figures as the division of a triangular prism into three equivalent triangular pyramids. Each pyramid can be drawn in its proper position in the triangular prism with a different color and the student then can see the relation of each pyramid to the other pyramids and to the entire figure without stopping to hunt for letters. Furthermore where a red triangular pyramid and a green triangular pyramid have a line AB in common that line can be drawn in the two colors, red and green, side by side, to distinguish it from those edges which are not common to two pyramids.

Another illustration in solid geometry is to show the intersection of two planes where each plane is drawn in a different color and both colors are drawn side by side for the line of intersection. Such a device is of real help to students who have great difficulty in the visualization of three dimensional space.

### *Emphasis*

Common errors can be pointed out by using colors for the correct procedures without the danger of strengthening wrong ideas by calling attention to them. Consider the operation of multiplication by zero, where the common error is to say two times zero equals two. If a set of equations such as:

$$2 \text{ times } 0 = 0$$
$$544 \text{ times } 0 = 0$$
$$x \text{ times } 0 = 0$$

are written with all of the zeros in a brilliant red, the picture of the equations with red zeros will remain long after the black and white equations are forgotten.

Another illustration is the correction of commonly misspelled words such as "adieu" which is sometimes spelled "adiew," or "integral" which some engineering students spell and apparently pronounce "intergal." One way to help remedy such misspelling is to write correctly in colors just that part which is commonly misspelled.

A third illustration, when using functional notation, is to emphasize the fact that if a substitution is made for a variable, it must be made in every place where the variable occurs but must not be made anywhere else. Such a function might be

$$f(\mathbf{x}) = 2y + 7\mathbf{x} + (\mathbf{x} + 2a)\sin \mathbf{x}.$$

Let us suppose that in this instance $f(x)$ is to be found for $x = 3$, then its value becomes

$$f(3) = 2y + (7)(3) + (3 + 2a)\sin 3.$$

If the letter $x$ is written in pink on both sides of the equation and if the number 3 is written in pink wherever the pink $x$ occurs, the fact will stand out boldly to the student that he must substitute the number 3 wherever $x$ occurs and that he must not substitute 3 for anything else.

### *Analysis*

Color will help to analyze the operations in some problems as no other method will do. Consider the simplification of a fraction which has common factors in both numerator and denominator. If each cancellation is made with a different color the variegated picture which results will show, clearer than a volume of words can do, every cancellation which is involved and, what is more important, where that cancellation has been performed.

Consider also long polynomials which

sometimes occur in engineering, mathematics, and the sciences, and which simplify to a large extent because they contain several groups that add up to zero. If a different color is used for crossing out each of the different groups which add up to zero, then it is easy to see just what is going on. Otherwise the student gets lost and confused and is apt to adopt the attitude that the operations are being performed by his instructor who never makes a mistake, and hence they must be correct. Such an attitude makes for poor teaching.

*Miscellaneous*

Correcting examination papers with colored pencils can prove very informative to a student. The instructor can write on the examination paper useful hints and corrections and there never is any argument when the paper is returned as to who made the corrections.

Another use for color is in keeping records of students where a number of examinations are given during a term. Here subtotals or percentages can be written in red along the same line in which the individual records are written with some other color. Thus the general trend of the work habits of a student becomes easily apparent. Such a trend, if downward, can be called to the student's attention before it is too late and such constant vigilance on the part of an instructor gives to the class the very important impression that he is on the job every minute.

Some interesting by-products of using color occasionally turn up. For instance, there once was a student who complained that at times his instructor claimed he was drawing some lines, but the lines never appeared. The mystery of the vanishing lines was solved when an investigation disclosed that their strange disappearances always happened when the instructor was using red chalk on a dark blackboard. It turned out that the student was color blind and had not been aware of it.

A word of caution should be noted here about which colors can be used. Many chalks on the market are so dark that they do not show up well on the usual blackboards. Golden orange, pink, apple green, sky blue, straw yellow, and other pastel shades show up the best.

Another caution that should be observed by instructors using colored chalks for the first time is the question of allergies. Some hardy souls can handle anything but some instructors, who have no trouble at all with white chalk, have been known to be allergic to a few of the dyes which are used to produce some of the colors.

*Interest*

Leaving everything aside, if all the reasons just advanced for using colors in the class room were invalid there still would remain the best and most powerful argument for their use, and that is their arousal of interest.

In some respects the world of black and white is a world of unreality. Who ever heard of eating a black and white tomato? The classroom should stimulate real life conditions. White has a discouraging bleakness about it that discourages morale. There is physical fatigue in distinguishing white from black which is not present when colors are used.

On the other hand, the teacher who uses color has an added device for focusing attention. Not only are colors more pleasing to the eye, but sometimes they stimulate the curiosity of a certain type of student and keep him guessing as to which color his instructor is going to use next.

Furthermore, under proper conditions, color can have a dynamic effect. For instance, some color specialists maintain that magenta lights at parties have the same effect on guests as at least two cocktails, but at considerably less expense and without any unfortunate after effects.

Colors are sweeping the business world today as they never have before. Just notice the increasing number of pages in color which magazines, such as the *Saturday Evening Post,* are producing each week. One commodity after another has capitulated to their sales-building influence. Colors liven the senses and keep the

individual alert to action. They do not give the mind a chance to brood. People are more carefree and happy, and are more active in a setting of nature in her most beautiful dress of sunlight and bright colors. Color, with its gorgeous reds, brilliant greens, sparkling yellows, vivid blues, and deep purples, can cover the entire visual field with a minimum expenditure of physical effort.

If all this is true and it seems reasonable that it is so, instructors ought to replace their grim and dismal whites and blacks in the classroom with colors, and make their lectures more fascinating and interesting.

## *Young Faculty Members . . . . .*

# PAPER COMPETITION

**ELIGIBILITY:** Members of ASEE not over 36 years of age in June, 1953.

**AWARDS:** First prize $200—Second prize $100.
Awards will be presented to recipients at the Banquet at the Annual Meeting of ASEE, University of Florida, June 25, 1953.

**SUBJECT:** Papers should deal with some constructive phase of improvement of engineering education. Participants are encouraged to select their own subject matter and titles within the broad framework of improvement of engineering education. In general, the papers should not be of a technical nature. The following are suggestions of the type of subject matter to consider:

a. How can the student learn to deal with new and unfamiliar situations with originality and well-ordered professional thinking?

b. What are the most important qualifications of undergraduate teachers of engineering?

**SUBMISSION OF ENTRIES:** All papers are to be submitted to the Chairman of the ASEE Section to which the participant belongs. For a list of Section Chairmen, see the Section Meetings, page 185 in this issue of the Journal. For further information and final date of submission of entries, write to your Section Chairman.

**JUDGING:** Each Section will appoint its own judging committee and select one winning paper. The winning papers from the Sections will be reviewed by a national judging committee for the final awards.

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# The Secondary School as a Source of Candidates for Engineering Training*

By HARRY A. JAGER

*Chief, Guidance and Personnel Services Branch, Division of Vocational Education, Office of Education, Federal Security Agency*

The subject, "The Secondary School as a Source of Candidates for Engineering Training," is chosen advisedly. The presentation about to be given was selected presumably because the assistance of secondary schools and particularly of guidance services was recognized as crucial to filling the ranks of engineers to the extent necessary in the manpower requirements of these times. This request reflects the far-sighted policy of the Engineer's Council for Professional Development and its Guidance Committee; of the American Society for Engineering Education; and of the Engineering Manpower Commission of the Engineer's Joint Council, in their task of mobilizing the engineering profession to meet current demands.

### *Some Basic Assumptions in Secondary Schools*

Secondary education, fortunately for these purposes, is at the moment in the midst of a great development of guidance services which have among their objectives a choice by young people of the kind of work they should engage in, their training for it, entering upon it, adjusting to its conditions, and progressing in it. These objectives, often known as those of vocational guidance, are really part of a larger program more appropriately named guidance services. They are now manned in thousands of schools by persons called counselors, whose ideal preparation consists of a comprehensive range of training derived from what amounts to a new discipline among the professions. The implications of these guidance services extend from the earliest grades through the colleges and universities and into adult life. They are important not merely for choosing a vocation, and other problems of individuals, but also for many activities of teachers and even for the course of curriculum development, functions which are more and more making them integral with the total educative process.

The expression "thousands of schools" leaves a considerable gap in a program where even more thousands of schools are without trained counselors. There are hopes that these gaps may be filled at an accelerating pace. Since, however, they still exist, any plans aimed at increasing the supply of engineers in which secondary schools are involved must be usable by all schools. It is impossible to reach enough persons to answer the needs of the engineering profession unless all students enrolled in high schools, large and small, rural and urban, with or without organized guidance programs, are included in the group.

One reason for this introduction to this talk is the need for recognizing a fact which is not always apparent: Neither secondary schools nor guidance services either are or can be engaged in a program of recruitment as such. The point of view which must be maintained is that young people in a democracy have a free choice in matters of training and

* Presented before the Engineering Section of the Land-Grant College Association November, 1951 in Houston, Texas.

vocation. These choices should be based on their knowledge of their abilities and interests as well as a familiarity with all opportunities open to them in the economic world in the light of these interests and abilities. Any warping of this objective approach in the interests of a need, no matter how critical, would be a subtle but real undermining of the democratic process. This protection of the intelligent self-interest of the individual is, it is believed, in no wise irreconcilable with an increase in the supply of *suitable* candidates for the engineering profession. On its merits, engineering is a good choice for many young people who are now not considering it as a career. It not only fits their pattern of abilities, but in sheer numbers among all professional opportunities has unquestionable rights for attention.

The reservations just cited, it is thought, present no real barriers to the engineering profession as it seeks more and better candidates for its ranks. They do point out, however, channels of approach which, if somewhat restricted, strike straight and sure to the goals established. Meanwhile the schools seek answers to several questions.

### *What is the Demand and Supply with Respect to Engineering Candidates?*

The first question that we may examine is "What are the needs for manning engineering and what is the supply in secondary schools to fill these needs?" The year 1951 is chosen as the point of orientation, both for high schools and engineering colleges. The choice of a current year enables us to deal at least partly with facts rather than prophecies, and reduces data based on estimates to a minimum.

From a report entitled "Engineering Manpower in the United States," by Armsby,[1] certain facts can be assembled. These facts in turn refer to an earlier paper, "The Future Supply of Engineering Graduates," also by Armsby and dated June 1950. Here are some interpretations of these facts in certain significant relationships:

The estimated need for new engineering graduates for civilian purposes in 1951 is 70 thousand, a number expected to be reduced as the years go by until the permanent need settles to about 30 thousand a year. As a compromise, 35 thousand is accepted as a reasonable goal, partly because engineering degrees in 1951 were approximately of this order. (The actual figure was 38 thousand.) The number of high school graduates in 1951 was some 1 million 240 thousand, of whom approximately 600 thousand were boys, the only realistic source for engineering material at this juncture. To produce 35 thousand graduates over a period of years and in normal times (this is, discounting veteran enrollment) 70 thousand freshmen are required, because approximately only *49 per cent of freshmen survive to graduate.* Seventy thousand freshmen is about 11 per cent of all the boys graduating from high school in the current year and in any of the next 4 or 5 years to come. But for all practical purposes, only the top half of the boys in any graduating class are acceptable for college entrance, which raises this figure to 22 per cent of boys available in any year. In other words, to satisfy the estimated need for engineering freshmen, 1 boy out of every 5 going to college from all graduating classes must choose to study engineering. Over against these figures is the fact that the best authenticated percentage of high-school graduates becoming engineering freshmen over a period of years is 2.9 for the entire group, which, reduced to boys only, becomes 5.3, and to the top half, 11.6 per cent.

A most significant question arises here: Is there any reasonable expectation that the proportion of boys not merely choosing engineering but also qualified to take

[1] Address before the Upper New York Section of the American Society for Engineering Education, October 1951, by Henry H. Armsby, Associate Chief, Engineering Education, U. S. Office of Education.

engineering can be doubled this year or in any year to come?[2]

The answer to the question just proposed is apparently a resounding "No," and for several reasons. One is that college students for all goals must come out of not more than the top half of boys in the average graduating class. A second is that thousands of small schools do not offer some of the courses considered essential as preliminaries to engineering education, so that the total of boys available is appreciably less than the 300 thousand in this top half. A third is that practically all the old professions, except perhaps law, and some new ones, are making similar claims fo undermanning, and are endeavoring to get, maintain, or increase their shares of the national quota. Recruits for one profession cannot be doubled except at the expense of one or more groups. In the fourth place the alleged instability of engineering as a permanent career has attained so much prominence that boys looking 5 or 6 years ahead may well question, not the figures proposed by learned societies and Government agencies which they know nothing about, but whether they actually will have a job in engineering when they want one 5 or 6 years from now.

At this point someone may say, "Let us enroll the girls." This may be a feasible recourse, but any feeling of complacency or magnanimity involved in this decision will meet with immediate deflation. It the hurdles of suitable interests and aptitudes (abilities are omitted because all measurements indicate that girls equal boys in range and amount of abilities) and acceptability on the job are waived, the recruiters will be faced by the current enormous demands for girls in the "women's" professions—nursing, teaching, and office occupations. In addition dozens of fascinating fields have opened up for women in the last 10 years which would compete at least on even terms with engineering. Finally, want-advertisements in the newspapers of our larger cities are offering young women with a minimum of experience and perhaps no more than a year's education beyond the high school, salaries which compare very favorably with entrance salaries for male engineers. And, after all, what most girls want to do is to get married.

This dilemma is not one which faces engineering alone. It is part of the situation which has increased the labor force to our current 65 million, has reduced the unemployed group to a mere million or so, and which can depend upon the 2 million young people reaching 18 years old each year as the only permanent and reliable addition to its numbers. Since the military can and will enforce its demands before those of any other labor requirements, the situation has reached a stage as crucial as has ever faced the Nation. Engineering, like all other professions, must face these facts and arrive at some workable compromise to achieve its goals.

To sum up: If the boys needed are actually available from current high school graduating classes, the supply is strictly limited and offers no hope that ordinary recruiting can draw from a inexhaustible group of candidates. If needs in engineering are stated accurately, other measures are called for.

### *How Does "Normal Attrition" in Engineering Schools Affect the Problem?*

The second question in which secondary schools are interested is, "What happens to our boys after they enter the engineering school?"

From the sources already cited appear devastating facts. There can be little expectancy that, taking all institutions as a group, more than 49 per cent of engineering freshmen will become graduates: that is, roughly 1 out of 2 is lost. This process has frequently been described as "normal attrition," as if boys were particles on an emery wheel which can be justifiably re-

[2] The military service question is deliberately left out of these calculations. If it were included all figures would likely be worse from the point of view of engineering goals.

duced to sparks, dust, and heat, provided the engineering profession attains its proper polish. Since a school regards every pupil who attends it as something precious with inalienable rights of his own, "normal attrition" is a phrase not merely repugnant to school people as a whole, but particularly repulsive to those engaged in the guidance profession.

Attrition figures apply to other colleges than engineering schools and, in fact, engineering schools do better than 4 out of 7 other professional schools in these respects. It is true also that almost the same figures apply to young pepole who are graduated from high school as compared with those in the sixth or seventh grade, but this condition is recognized as an evil against which many campaigns for staying in school are addressed, and which has been overcome in some states so that 90 per cent or more young people of high school age are in high school. In any case, in these times when no manpower can be wasted, the phrase "normal attrition" should be analyzed. If it represents evils which can be remedied, any campaign in secondary schools should be buttressed by evidence, first, that this evil is known and, second, that steps are being taken to remedy the causes, at least in so far as they are remediable.

Diligent search has not revealed any national study of the causes for attrition since the bulletin, "College Student Mortality," published in 1937 by the Office of Education and sponsored by 25 university projects staffs. Although 14 years may have changed details, in the absence of other evidence the data cited may be deemed acceptable, with whatever reservations may be necessary in view of changed conditions.

In this study of 100 students who left schools of engineering before graduation (the total number on which the figures were based is 1544), 19.9 per cent were dismissed for failure in work; 3.2 per cent for lack of interest; 1.1 per cent for disciplinary causes. These three are grouped together since they may be considered to have relevancy to each other, and make a total of 24.2 per cent, or a quarter of the number. Ten and seven-tenths per cent left for financial reasons. Death and illness accounted for 4.1 per cent, miscellaneous causes for 13 per cent, and *unknown causes for 48 per cent.* Of all these causes only a few can be accepted as based on firm evidence, of which the most stable is probably that for death and illness and that of low scholarship grades. The most startling fact is that nearly half the cases involved youth who made so little impression upon the institutions that they dropped out of sight without anybody knowing why, and another eighth were but dubiously classified as "miscellaneous."

Undoubtedly better student personnel programs established in engineering schools within the last 14 years are responsible for reducing mortality rates from 60 per cent noted in 1938 to 51 per cent acknowledged today. Current figures merely cite the total number in the freshman class and the total number of graduates. There has always been a steady influx of transfers into the advanced classes in engineering schools, and it is possible that a study based on individual survivals, as the 1937 study was, would show worse figures than those available now.

### *Relation to the Manpower Problem*

The interests of secondary schools in these facts, grave as they are, are of less consequence than their relation to the manpower problem. Neither an institution training for the professions, nor any employer, can, under current circumstances, ask for two persons to be assigned to it so that it may at its leisure choose one and reject the other. During the more or less prolonged period in which the individual is retained, although ultimately rejected, he is deprived either of some training in which he might succeed better, or of participating in production, and of not only earning his living but even of doing his share in the defense of his country, both on a civilian and a military basis. To the extent that this practice is

sheer waste, it should be eliminated at once. Of all professions, engineering, which has as its goal the scientific adjustment of means to ends, should be the most eager to eliminate waste in its own house.

It is not the purpose here to place any blame in these respects, in which all educational levels from the first grade up are culpable. But from the point of view of young people, parents, and the secondary schools which are asked to aid in recruitment, certain statements might not seem out of line. For instance, engineering schools, ordinarily admit freshmen by their own standards applied to preparatory subjects, rank in school, and personal characteristics, all of which are a matter of record in most schools, and should be in every school.

Tools for evaluation and selection, long a matter of study by authorities, including members of your own guidance committee, are increasingly accurate, both for selection and admission purposes. Should then 1 in 4 (9 thousand on a basis of 35 thousand drop-outs) engineering students leave college because of their inability to be interested in or succeed in their studies? How much of this assigned cause has its roots in poor teaching, obsolescent subject matter, crowded sections, or the lack of application of those very tools of evaluation to the teaching process in college? How much is caused by institutions bypassing, or failing to apply strictly, accepted standards in case of entering freshmen? The dilemma's two horns are: If these drop-outs are inept, how do they get into the institution; and if they are apt, why do they fail?

Or, again, is there any excuse whatever for any able student's leaving for financial reasons as 1 in 10 (3500 persons) do? If public funds are not available to keep these young people in school, why should not those employers to whom the young engineer is the most precious of all commodities hesitate to supply enough money for this purpose, a sum negligible compared to amounts now spent, let us say, for such recognized needs as advertising and research?

Thirdly, what about the 50 or 60 per cent (18,000) who leave for "miscellaneous" or "unknown" causes, who must be so classified only because enough pains have not been taken, first, to learn the causes of maladjustment as they accumulate, and secondly, to remedy the very large number of cases which are undoubtedly remediable?

It is clear that numbers of these questions are not now answerable. It is readily admitted that many institutions are studying them and doing what is possible to change conditions. But extraordinary times demand extraordinary measures. A profession cannot demand the doubling of its quota of young people who choose it at the expense of other professions, and at the same throw to one side half the young people who actually are admitted to training. In the presence of so many emergency measures, many of them involving billions of dollars for which no one questions the value received, the engineering profession can well recommend and adopt measures which will answer at least in part this charge of waste. It should be clearly kept in mind that both on the basis of experience and of prophecy, 35 thousand graduates in engineering involve another 35 thousand real persons, mostly from the top half of ability among the boys in graduating classes of all high schools in this country, who land in the discard. The question of their partial gains from what engineering work they have received and their presence on the campus, as well as the fact that they are undoubtedly absorbed promptly somewhere in the military or civilian labor force, is beside the point. They have not proceeded to their chosen objective. The time, money, and resources devoted to making them engineers is, for that end, wasted. And most of all, the future score in frustration and maladjustment of everybody concerned is only beginning to be realized.

### *The Case for Engineering As a Choice of Profession*

What is the case for engineering as a career which warrants its consideration by any bright and apt high school pupil? On its merits, a strong one. Current estimates place 3 million men in the professional and technical segment of the labor force, of whom 400 thousand are engineers, approximately 13.3 per cent, or better than 1 in 8 of all professional jobs. In schools in which a professional career is the obsession usually for more than half of all those enrolled, a profession which supplies 1 job out of every 8 has a strong claim for consideration. As a matter of fact, in this ratio it would supply careers for 37.5 thousand out of the 300 thousand boys in the top half of the graduating classes—a figure corresponding approximately with some of the estimates as to the stable needs of the country for engineering graduates.

Again, enough high school students who have the necessary abilities to warrant an expectation that they are likely to succeed in engineering can probably be identified and become available. Fortunately the valuable work done by the Guidance Committee of the E.C.P.D. is supplying criteria which can be applied to every high school to aid in judging in these respects.

Thirdly, as young people study the social and economic significance of the professions, engineering has claims which are only partially either understood or advanced in the consideration of a career. Rightly or wrongly, in this atomic age they are achieving emphasis out of proportion to anything that has happened up to this time. It would be of advantage even to engineers in this connection to review the remarkable chapter by Stuart Chase called "Prometheus Enchained" in the A.A.E., publication of 1933 entitled *Vocational Guidance in Engineering Lines.* The influence of this social importance, of this appeal to idealism and its leadership, for young people can scacely be overemphasized. The usual approach of wages received, the prestige involved, and the ultimate command of wealth are powerful stimuli, it is admitted. Yet all young people from 15 to 18 have a strong strain of idealism which leads them to give a ready hearing to proposed life work which enlists them in the betterment, not merely of their own country, but also of the world. To attain this understanding, of course, something more than the processes of selection and vocational guidance are necessary. Into the teaching of the school must go new elements, especially in the social studies curriculum. This approach is difficult, but numerous attacks are already being made as, for instance, by the Joint Committee on Economic Education. The point is that engineering as a profession should early enter the consciousness of the adolescent, and accumulate in force for sound and broadly based reasons rather than as a result of the impact of recruiting posters and emergency decisions.

### *What Can Be Done?*

What can be done in engaging secondary schools in a serious cooperative endeavor to supply engineering skill to the Nation should be settled on a realistic basis. Any plan advanced should be founded on facts of manpower, the purposes of high schools, the ability of engineering colleges to cooperate, the good will of active members of the engineering profession, and most of all on a simplicity of operation which will enable any high school, not merely the large and well-equipped school, to take advantage of it. The last item is emphasized because 60 per cent of the high schools in the country, enrolling 40 per cent of the population, have 200 or fewer students. They are lacking courses, staff, and guidance specialists and yet enroll so considerable a number of desirable engineering candidates that it is fatal to neglect them.

1. The first step would appear to be a quota of students to enter engineering based on stable rather than emergency needs, and on the reasonable supply of such students in view of all the circumstances mentioned above. It is assumed that no quota established in this way can

possibly allow for a 50 per cent drop-out rate.

2. Engineering institutions should examine their admission procedures to make them better selection devices, in cooperation not merely with schools with good guidance programs, but also with schools which need much assistance in arriving at suitable criteria. They should make a rigorous examination of internal causes for drop-out, with some fixed objective of reducing the drop-out rate by a considerable percentage within a period of time. This undoubtedly would require the provision or the expansion of student personnel programs in all institutions.

3. The valuable work of the Guidance Committee of E.C.P.D. should be extended. Essentially the plans of this Committee consist of 3 items: The establishment of evaluative criteria in specialized subject matter and in personal characteristics, the furnishing of professional information about engineering, often referred to as "guidance material"; and enlisting the services of members of the profession in the areas of local high schools to furnish personal advice to young people, singly or in groups, who are investigating engineering as a profession.

One of the weaknesses in this program is the inability of many schools to take advantage of it. They do not have or cannot administer and interpret the standard tests involved. Their records do not supply cumulative information about their pupils activities from which their attitudes and habits of thinking may be estimated. They do not have a skilled counselor able to prepare the way for, or to supplement, the information and counseling supplied by the local engineer. They may even lack one or two of the courses essential in engineering preparation, and may be unwilling or unable to adopt emergency measures such as correspondence courses or unorthodox class room groupings, to supply these lacks.

4. Efforts should be made to insert into the curriculum essential facts about the importance of engineering in the prosperity and happiness of the world. A better understanding of the function of engineering in realizing the ideals of the United Nations, UNESCO, of the foreign-aid program, and of the defense against the common enemy should be sought. This, it should be understood, is not a guidance problem, but an instructional problem.

5. A concerted attack should be made on the resources offered by the boys in the small high school who are unable to obtain advanced mathematics or science course. The evidence mounts that lack of training in specific subject matter fields is a relatively unimportant factor in the success of students in colleges. Quality work and other evidences of ability and character in high school are far better auguries of success in college than the passing of an elaborate group of required units. A recent study at the University of Michigan not only established these facts, but also that the size of a high school from which a student graduates offers no correlation with his success in that institution. The candid waiving of certain subject matter preliminaries in the case of able students to whom they are unavailable, even at the expense of teaching them these elements after their arrival on the campus, would probably result in an appreciable addition to the number of acceptable freshmen in engineering classes.

6. Some better means for the placement of young engineering graduates and the protection of their job and employment rights should be a common objective of the engineering profession. Disturbing reports of some ruthless practices involving the hiring of more young graduates than the corporation needs, with the deliberate but unannounced purpose of reducing the number by the end of the year, have appeared. The immediate closing down or the reduction of experimental and research staffs at the slightest subsidence in business activity, leaving young engineers without jobs and often without homes, but with beginning families, should be examined. The reason for the rapid fluctuations in the ratio between engineers

and production workers should be looked into. Any widely advertised estimates on the demand and supply of engineers, whether they err on one side or the other, should be subject to much greater scrutiny if they are to avoid giving the public the idea that engineering is an unstable profession. All of these suggestions are more in the form of questions than of statements, the answers to which may prove that the implied criticisms are without foundation. It cannot be denied, however, that to an outside observer a determined effort to remove the causes even of the unfounded rumors should be made in the interests of helping young people to arrive at decisions about engineering as a career.

*Conclusion*

In conclusion it should be said that the engineering profession will meet with eager cooperation from high schools, their teachers, and their counselors. They will welcome any opportunity to replace the vague aspirations of young people seeking a profession with sure grounds for an adequate choice in a career with specific goals, even if these do not promise to lead to the end of the rainbow. The schools recognize their own weaknesses in their present handling of these situations. They will welcome any aid, whether materials, personal assistance, or professional advice, to help their young people. They know as well as any that the welfare of a profession depends upon the welfare of each member, and the productivity of a worker at any level is to a large degree the result of his reasonable adjustment and of satisfactions often measured in imponderables.


# Centennial Issues of the Journal of Engineering Education

The December and January issues of the JOURNAL OF ENGINEERING EDUCATION will contain papers which were presented at the Centennial of Engineering in Chicago in September. Extra copies of these issues can be obtained for $1.00 per copy by writing to the American Society for Engineering Education, Northwestern University, Evanston, Ill.

# Teaching Aids for Heat Transfer and Thermodynamics

By W. J. KING

*Professor of Engineering, University of California at Los Angeles*

During the spring of 1951 the writer undertook to canvass a representative group of engineering schools throughout the country in an attempt to discover what sort of aids were currently being used in teaching heat transfer and thermodynamics. As far as he was able to determine, very little of anything in this category is being employed in the classrooms. Following is a list of the gleanings from this survey:

### *Films*

Professor McAdams, of M.I.T. has a film on "Visual Studies in Boiling," showing the formation of vapor bubbles on a heated surface. Mr. A. C. Mueller, of du Pont, has similar films on boiling heat transfer.

Professor Alan Colburn, of Delaware, has several films of heat transfer in heat exchangers, including tubular oil coolers.

C. F. Braun Co., Alhambra, California, have similar films of the action in heat exchangers.

Combustion Engineering-Superheater Company have an interesting colored film of combustion in the furnace of a large boiler.

Dr. E. Eckert, of the Power Plant Laboratory, Wright Field, Dayton, Ohio, has a film of interferometer studies of free convection in air. Mr. C. Coulbert, of U.C.L.A. has a similar film.

### *Models*

Professor C. O. Mackey, of Cornell, has developed a hydraulic analog for demonstrating transient flow of heat, representing temperature in terms of the head of liquid standing in a series of small glass tubes, and heat in terms of rate of flow of the fluid.

Mr. A. J. Jackson, of Corvallis Heights, Oregon, advertised a remarkable transparent model of a 4-cycle engine, with hand-crank for rotating the shaft and exhibiting motion of all components, priced at $27.00. This was imported from abroad, and he anticipated that "other transparent machines and common engineering equipment may soon be available."

The Econolite Corporation of 3517 W. Washington Blvd., Los Angeles 18, California, manufacture a variety of animated, illuminated translucent colored charts, some of which show the action of various types of boilers and furnaces. These displays are quite striking and although developed originally for commercial advertising they should be quite effective as teaching aids, especially if adapted to illustrate the fundamentals of heat and thermo.

### *Charts*

The W. M. Welch Manufacturing Co., of 1515 Sedgwick Street, Chicago 10, Illinois, distribute an excellent series of charts on chemical, physical and metallurgical subjects, including an elaborately illustrated 64 × 42 inch chart of Electromagnetic Radiations, edited by A. H. Compton. This chart shows very graphically how thermal radiations fit into the spectrum, and relates all forms of radiant energy to a great variety of phenomena

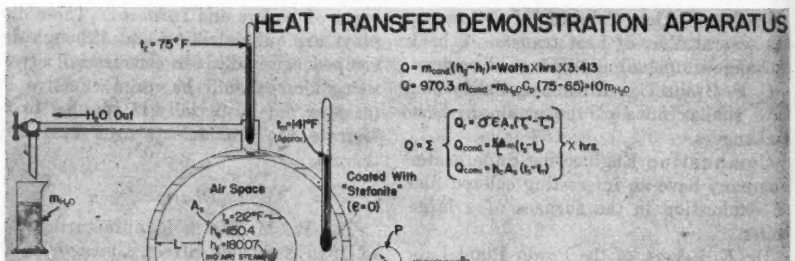
and apparatus. The Welsh Company expressed an interest in publishing special charts on other subjects "if the quantities would be 200 or more."

*Suggestions for New Teaching Aids*

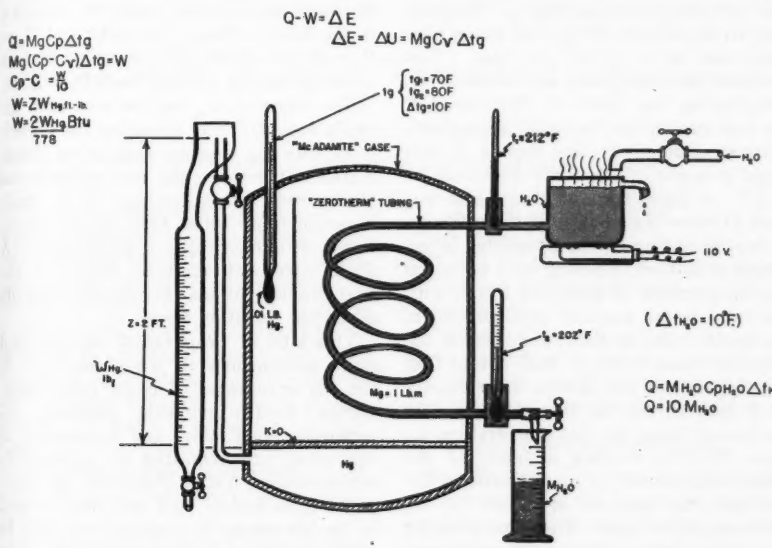
Some time ago the writer became interested in constructing demonstration models for use in the classroom to illustrate some of the fundamentals of heat and thermodynamics. In considering the design of such apparatus it soon became evident that the inadequacy of available materials would make it very difficult to show the students what was going on inside, during the demonstration. Even if the interior could be observed through transparent walls or windows, the heat flow could not readily be confined to the desired channels and media. Heat has a notorious tendency to leak or radiate in all directions, and the thermal conductivity of the best insulators leaves much to be desired. It was therefore finally decided to circumvent all of these difficulties, together with most of the expense, by constructing "two-dimensional appartus," in the form of large charts, employing special materials "invented" for the purpose.

Two of these charts are shown in the accompanying photographs.

The Heat Transfer Apparatus is designed to demonstrate the effects of pressure upon the conduction, convection and radiation of heat across the air space between two concentric spheres. The inner sphere, of thin-walled metal, is uniformly heated to 212 F by pure steam supplied by an electric boiler regulated to hold the pressure at 1 atmosphere. Boiler jacket and transmission losses are obviated by lagging all hot surfaces with a material having zero thermal conductivity ($K = 0$) and the tubing between the inner and outer spheres is made of this same material. The total heat flow ($Q$), across the air space is thus equal to the mass of condensate ($M_{\text{cond.}}$) collected in the lower graduate during any interval of time, multiplied by the latent heat of the steam ($h_g - h_f$), and is also equal to the watt-hrs. input to the boiler $\times$ 3.413. All of this heat is absorbed by the cooling water jacketing the outer sphere, and is equal to ten times the mass of water collected in the upper graduate. (All three of these values of $Q$ are measured during each run and any lack of agreement in-



FIRST LAW DEMONSTRATION APPARATUS




dicates faulty operation of the apparatus. Thus far no trouble at all has been experienced.)

The thermometer for measuring the mean temperature of the air ($t_m$) is coated with "Stefanite," a secret new material having an emissivity, or absorptivity, of zero for all radiations. The convection component, $Q_{conv.}$, could if desired, be measured in terms of an overall coefficient, a mean surface area, and the overall temperature difference ($U_c A_m (t_s - t_w)$, instead of $h_c A_s (t_s - t_m)$).

The apparatus is initially operated with atmospheric pressure in the air space. The conduction, convection and radiation components of $Q$ are expressed as 100%, severally, as shown in the graph at the lower right. The vacuum pump is then started up and the air space pressure is reduced to ¼ atmosphere. At this point the conduction and radiation components remain unchanged, but the convection has been reduced to half of its original value. The original magnitude of the convective heat flow can then be found from the relation: $Q_{conv.} = 2(Q_{1\ atm.} - Q_{1/4\ atm.})$. The air pressure is now reduced to zero, which eliminates both the convection and the conduction, leaving the original radiation still unchanged. The initial conduction component can then be computed from: $Q_{cond.} = Q_{1\ atm.} - (Q_{conv.} + Q_o)$. These results check remarkably well with the values for the components computed from the three formulas above the vacuum pump, using appropriate values for $\epsilon$, $K$, and $h_c$.

### *The Problem*

The First Law Apparatus demonstrates the significance of $C_p$ and $C_v$ in operational terms and illustrates an elementary energy balance. The problem here was to make sure that all of the heat lost by the hot water in passing through the coil of tubing was delivered only to the one pound of gas trapped within the tank. If the tank case were made of any ordinary material it would absorb or trans-

mit more of the heat than was added to the gas, necessitating a large and uncertain correction in computing $Q$. The mercury in the bottom of the tank would likewise soak up a lot of the heat. This problem was solved very satisfactorily by constructing the tank of "McAdamite," the new hypothetical material having zero thermal conductivity and named at this point in honor of Professor McAdams of M.I.T. A liquid form of McAdamite was used to cover the surface of the mercury.

For measuring $C_p$ the apparatus is operated as follows: Starting with an initial gas temperature of about 65 F and with the valve in the mercury vent tube open, the needle valve at the lower right is adjusted to pass water at such a rate that its temperature will always drop exactly 10 F between the two thermometers. At the instant when the gas temperature, $t_g$, reads 70 F a reading is taken of the amount of mercury in the graduate at the left and the amount of water in the graduate at the right. The same readings are taken when the gas temperature reaches 80 F. From the differences, the weight of mercury ($W_{Hg}$), and the mass of water ($M_{H_2O}$) are computed and used to obtain the values of $Q$ and $W$, as shown in the chart. Then, $C_p = Q/10$ and $C_v = C_p - W/10$ (where $W$ = total work done in lifting the Hg through the 2-ft.-height).

The value of $C_v$ can be measured directly from $Q/10$ by repeating the experiment with the mercury vent valve closed. Agreement between the two methods has always been within less than .01%, which is considerably better than is usually obtained with other types of apparatus. (A slight correction must be made for the heat capacity of the thermometer and its silver-foil radiation screen.)

This kind of "apparatus" may be used quite conveniently in the classroom. It has the advantages of being fully transparent, readily portable, relatively inexpensive, very quiet and economical in operation, and requiring no appreciable maintenance. Yet it illustrates the principles quite lucidly, and can even be used in the laboratory by students who may be asked to obtain (hypothetical) test data from it!

* * *

# ERRATUM

Apologies are due Professor V. M. Faires of North Carolina State College whose name was inadvertently omitted from the published list of the members of the Committee on Improvement of Teaching. The Report of this committee was published in the September issue of the JOURNAL OF ENGINEERING EDUCATION.

# The Use of Films as "Outside Assignments"

By HARVEY WILKE

*Associate Professor of Sanitary Engineering, Purdue University*

The civil engineering curriculum of most engineering schools includes a course or courses in Water Supply and Sewerage. Unless special sanitary options or technical electives are available, it is frequently the students' only contact with the problems of sanitary engineering. The content of such courses in Water Supply and Sewerage generally includes the hydraulics of water distribution systems, water treatment processes, design of sewage collection systems, and sewage treatment processes—usually it is a senior course.

Unfortunately, there are always many of these senior students who have never visited a water plant or a sewage plant. Furthermore, the students who have visited such plants do not always possess an appreciation of the processes involved, the equipment used, etc. After all, it is difficult to know the design features of equipment submerged by water or sewage, or housed in sealed structures. Although some inspection trips include visits to a water plant and a sewage plant, it never is as comprehensive as might be considered desirable.

Recognizing that a certain amount of descriptive material is essential to the proper understanding and comprehension of water and sewage treatment processes, an experiment was tried in which the students had opportunity to view motion pictures and slides pertaining to the subject material of our *Water Supply and Sewerage* course. The films that are used either supplement or emphasize the lectures and text assignments. These films constitute one hour per week and are designated an "outside assignment." During the fall semester, 1951, they were shown twice each week, Thursday at 2 P.M. and Friday at 2 P.M. to provide all students an opportunity to get to one of the showings.

Purdue's *Water Supply and Sewerage* course consists of three class periods and two two-hour design laboratory periods each week—total credit of 4.3 units.

### *Capabilities and Limitations*

It might be well to review briefly some of the capabilities and limitations of films for college instruction. To begin with, many films are limited in their ability to develop the students' reasoning or thinking powers. On the other hand, for a subject of this nature, a certain amount of basic imagery is necessary to comprehend design requirements of equipment or structures. They give the student a pseudo-experience. They also provide a vivid imprint on the student's memory. To be more specific, here is what films can do for a course in water supply and sewerage:

1. They can show complex details of water and sewage treatment operations. By animation these processes are capable of being viewed in stepwise developments.
2. They illustrate fundamental relationships between water, sewage, and the health of a community.
3. They can picture water source problems—somewhat like an immensely expanded inspection trip covering both time and space.
4. They can show microscopic organisms which cause water borne dis-

eases and which are utilized in biological treatment. This would otherwise take long laboratory periods and tedious microscopic work.

5. They can demonstrate techniques and methods of distribution system and sewage collection system installation —the "how it's done" type of picture.

If this can be accomplished as an "outside" assignment, then by the more traditional classroom procedures the theory can be developed to a far better understanding on the part of the student. The mental stage is set, curiosity is developed, and the instructor can go on to a full understanding by classroom and laboratory problems.

Careful integration of the film material with classroom and laboratory material is essential. The films are not an end in themselves. In the one-hour presentations, each film is introduced calling attention to special features to observe, etc. An illustration may be stopped on the screen during the running in order to discuss or emphasize some point. Questions, comments, etc., terminate the showing. In some cases additional visual aids are employed after the films by exhibiting and discussing small models, cut-aways of equipment, samples, etc. Finally, the classroom and laboratory further develops the theories and technical phases that have been illustrated in the film material.

Some of the films are shown without using the sound track and, instead, my own commentary is given if it is necessary to substitute the technical for the more popular aspects. Incidentally, this does not mean other assignments are not made. Typical reading assignments, home problems, etc., plus the one hour of films, make up about 2 hours assignment and preparation work for every classroom hour. It does require some time and extra work on the part of the instructor. He must present the films twice. He must review possible new films for the series as this revision process must go on indefinitely. And a certain amount of getting-ready time is necessary.

Certain costs are also involved. Although some of our films are from the Purdue Film Library, others are rented or borrowed. Most of the commercially produced films have no rental fees. Mailing, insurance, and rental fees for the program amounts to about $50.00 per semester.

### *Precautions*

Some precautions are necessary. Regularity is important. If regular attendance is expected, "slip-ups" must be prevented. Promptness is essential. There have been occasions where a company has failed to send its film in time for a scheduled showing—several films that can be obtained on instant notice from our own library are available for such filling in. These films may be of only general interest and might lack some of the integration with the course and laboratory material, but such "slip-ups" do occur sometime and a filler is desirable.

Perhaps a yardstick by which to measure the usefulness of this program is the attendance figure and the attitude of the students. Attendance is voluntary and has average consistently ⅔rds of the 90 students enrolled this semester in the course. A few inevitably have work or class conflicts with both showings. A request for unsigned comments from ¼ of the enrollment showed that not one objected to the program—their comments ranged from just interested to very enthusiastic.

# Report of Special Survey Committee

As your representative to the Special Survey Committee of the Engineers Joint Council the following is a report of a survey conducted by our Committee pertaining to the supply and demand of engineers which has just been completed.

### *Supply*

Reports from 166 schools indicate that 27,813 first degrees were conferred during the period from July 1, 1951, ending June 30, 1952. It is, therefore, estimated that the total number of degrees given during the present academic year will approximate 30,000. These degrees were granted by accredited and non-accredited institutions. Of the schools surveyed 4,523 members are also receiving commissions in the Armed Forces. It is expected they will be called to active duty either immediately following graduation or shortly thereafter. This amounts to 16¼%. Of the group 1,266 or 4½% are enrolled members of the Armed Forces Reserves or National Guard, and 6,142 or 22% are vulnerable to Selective Service. There are 1,743 or 6¼% enrolled or seriously considering fulltime graduate study. Assuming, therefore, that there will be a very small loss or no loss at all to Selective Service, it is estimated that there should be available to industry approximately 22,000 to 23,000.

It is also interesting to note that the senior classes for 1952–1953 have an R.O.T.C. content of 22½%. The junior classes of next year represent an R.O.T.C. content of 45%, and the sophomore classes 55%. Although no concrete figures can be given, there is an indication that the mortality of the freshmen classes that entered last September, is lower than normal, which may be considered possibly as a hopeful sign.

### *Demand*

The Survey Committee have also conducted a survey on the demand side of the picture. Replies from 326 companies and 32 governmental agencies have been received. A rough check of this information indicates a demand by industry of something over 30,000. This should not be considered as a firm figure as much checking has to be done in order to determine whether or not the information received from the companies and governmental agencies is representative. This check is being conducted at the present time and a report will be issued as soon as possible.

Respectfully submitted,

MAYNARD M. BORING, *Chairman*

# A Plan for Training Women in Engineering

By FRED C. MORRIS

*Department of Civil Engineering, Virginia Polytechnic Institute*

For several months we have heard a great deal about the critical shortage of engineers. This information has come to us from all directions, newspapers, magazines, industrial bulletins, and the radio. It is variously estimated that the nation is short from 60,000 to 80,000 engineers. Based upon present college enrollment, there will be a severe drop in engineering graduates each year until those available for industry will almost reach the vanishing point in 1955. It is reported that there are some individual concerns now trying to recruit 1000 engineering graduates or more to meet their technical personnel requirements. This, of course, they cannot do because the graduates are simply not available. The Engineering Manpower Commission of the Engineer's Joint Council held a special meeting in Pittsburgh last September to try to find a solution to the problem. While no satisfactory solution has become apparent, the Commission has done a good job in letting the Congress and the public know of the seriousness of our plight.

The most important reason for our needing an adequate supply of engineers is, of course, the fact that we are engaged in a serious cold war with the communistic world. We do not know how soon this cold war might become a very hot war, the outcome of which will determine whether we will continue to enjoy our freedom or whether we will live in a state of virtual slavery. It is obvious, then, that the stakes in this conflict are very great indeed, and the freedom that we have fought for many times before could be snatched away from us. We should not underestimate the power of the 800 million people aligned against us, nor should we consider this a temporary emergency. Most likely, we are destined to face a terrific world population pressure for many years to come, and our freedom is secure only so long as we are able to successfully defend it. Our only hope in this direction is to maintain superiority in the field of technology; that is, we must always be prepared to meet the horde of manpower with overwhelming fire-power. In order to do this, we must not only keep the wheels of industry rolling at a high degree of efficiency, but we must at the same time advance technology. This is where the engineers come into the picture. Without their scientific knowledge, inventive genius, and technical know-how our American way of life would quickly be reduced to a pattern of life hardly worth the living. It is incumbent upon us all, therefore, to contribute as much as possible to the maintenance of our democratic form of government, each according to his talents.

Since it seems that the shortage of engineers may jeopardize our national welfare, the next question is what can we do about it. This is largely an educational problem, but it might be wise to approach it in the same manner that we would approach an engineering problem; that is, what results do we want and what do we have at our disposal to get these results. The basic facts in the case stack up something like this:

1. We are woefully short of professional engineers.
2. From 3 to 5 subprofessional workers are needed for each professional engineer.
3. Many professional engineers are doing subprofessional work because there is no one else to do it.
4. Most engineering colleges are not us-

ing their facilities to the maximum advantage because of the low enrollment.

5. There are many bright young women in college with inherent technical ability and many more graduating from high school each year.

6. While we lack an adequate supply of men for technical work, we do have a big untapped supply of women.

With these elements of the problem, it seems that the logical and intelligent thing to do would be to train women to do the subprofessional work in order to release the professional engineer for more important work. This would merely be doing the obvious, in which there is great virtue.

When the idea of using women in engineering work was proposed during the war, the engineers frowned with great misgivings. After the girls had worked for a while, however, the men discovered that they were really useful rather than just ornamental. The U.S. Office of Education operated the ESMWT short-course program for women, while some industries set up their own training program at a number of colleges. Many of the women who were trained during the war are still in engineering work and doing very well with it. In a speech made at the Virginia Polytechnic Institute on February 21st, Mr. Maynard M. Boring, Manager of the Technical Personnel Services Department of the General Electric Company, said, "Industry must make better use of women in technical work." The September issue of the *Scientific American* carried an article on mobilization prepared by Mr. Arthur S. Fleming, Assistant to the Manpower Director of the Office of Defense Mobilization. In the article Mr. Fleming made this statement: "In many professional and technical fields we shall not be able to solve our manpower problems unless we use women to a greater extent than we have up to the present time. To do so we must convince them that training for these occupations will give them an unusual opportunity to serve the nation during a very critical period."

Women have certain inherent characteristics which stand them in good stead. For instance, they are conscientious, they know how to use their hands, they are careful about detail, and quite important, they are not adverse to trying something new. Witness, for example, their proclivity to change the furniture around in the house about every three days to see if they can find a more efficient arrangement. This is exactly the procedure that our research scientists use; that is, if you don't know if something will work or not, try it and see. Quite often in scientific studies the going gets pretty rough and girls, being more sensitive and nervous than boys, sometimes become emotionally disturbed by overwork and the fear of failure. These troubles, for the most part, can be solved by the strategic use of a few kind words and a little human understanding. Girls will work their hearts out for you if you handle them right, which usually requires nothing more more than a sincere interest in their welfare. Even though girls will work very hard, they should not be accepted indiscriminately for engineering. If the use of women in technical work is expanded, every effort should be made to identify and interest only those who have shown distinct technical ability.

Since industry needs technical workers, and since the colleges have the facilities to train them, it seems that a working arrangement could be made that would be beneficial to both. For instance, it would not be at all difficult to incorporate one full year of engineering studies into the general science degree for those who want it, nor would it be impossible to do the same for those in home economics. This would involve credit hours only slightly greater than the number usually permitted for elective courses. Each college making this arrangement would have to work out the details of the course of study to fit its own local situation but, purely as a suggestion, the program might look something like this:

1. Mathematics to include College Algebra and Trigonometry.

2. One full year of Engineering Drawing.

3. One full year of Engineering Problems involving 12 hours per week of laboratory computations. This course would be designed to teach students how to apply fundamental principles to practical problems of the types most likely to be encountered on the job.

4. Other subjects to be studied might well be Freehand Sketching, General Physics, Materials of Engineering, Manufacturing Methods, and perhaps, Engineering Economics.

If a group of girls were studying to go to work in a particular industry, then the course of study could be designed to fit the needs of that industry.

Now let us see how this program would operate, what advantages it has, and what benefits might reasonably be expected from it:

1. Engineering colleges are already offering the courses that would be needed except the laboratory computations course in Engineering Problems. This course, however, would not be at all difficult to set up.

2. It would not be necessary to depend upon federal grants of money to operate the program. Students would merely pay the regular college fees as usual.

3. The full year of engineering would give the students much better preparation than the short-course type of 10 to 15 weeks which were run during the war.

4. It would help to accomplish our prime objective of supplying sub-professional workers to relieve professional engineers for more important work. These girls could take care of such things as drafting, production illustration, computations, time and motion studies, statistical work, and a multiplicity of other things of a similar nature. Also, a girl could act as an aide and understudy to a professional engineer. This would relieve him of the routine work and, at the same time, give the girl an excellent opportunity to expand her knowledge of engineering.

5. A qualified high school graduate could take the one year of engineering and go to work immediately. For a small investment of time and money she would be prepared to earn a good salary and could then use these credits later toward a degree.

6. Girls now enrolled in college could take the one year of engineering at the most convenient time for them; that is, the second, third, or fourth year. It might be possible to make arrangements with liberal arts colleges for interested seniors to transfer to engineering colleges for their fourth year of work. This would be particularly desirable for those who are majoring in Mathematics, Physics, and Chemistry.

7. Graduates in Mathematics and Physics might want to take engineering work during a fifth year in college, in which case it might be possible to design a program of study for them at a level that would justify the granting of a master's degree. If this is done, it would probably be better for individual industries to recruit these girls, perhaps from 25 to 100, and have the work designed to meet the needs of the industry. Based upon the number of students now enrolled in colleges and the anticipated need for technical personnel, industry can start now to prepare for the time when they will not be able to get enough engineering graduates to meet their requirements.

8. If the girls who take one year of engineering and work in industry for a while decide to go into educational work, they would make excellent science teachers for high schools. This experience would provide the background for teaching that many teachers do not have at present.

It would seem that the benefits mentioned in the foregoing should be sufficient justification for the serious consideration of a program to give young women a full year of training in engineering. In order to put a program of this nature in operation, the chances are that some inhibitions would have to be thrown overboard. This may be painful, but not fatal. The exercise of initiative, ingenuity, and some cooperation on the parts of the colleges and industry should contribute much toward relieving the critical shortage of engineers.

# Options and Ornamentalities *

## "Abridged"

By A. G. CONRAD

*Chairman, Electrical Engineering Department, Yale University*

Many years ago, I asked my predecessor, Charles F. Scott, why he was so insistent that his staff attend the SPEE meetings. He replied that it offered great opportunity for us to "listen to the deans and department heads tell about what a good job they are doing—particularly in playing checkers with the curriculum." It seems particularly fitting and historically correct for this meeting to have a couple department heads carry on this tradition and to recommend to you the proper proportions of the educational menu called the electrical engineering curriculum and to specify the content of these more choice morsels, commonly called options.

As outlined earlier by our chairman, my participation should be limited to a discussion of the power option only, and the communication option should be left in the more competent hands of my good friend, Professor Ryder. Then after Professor Ryder and I have exhausted our energies in attempting to prove to the world the vast importance of these two particular options, the third member of our panel will toss into the meeting a lighted firecracker which shall terminate some of the nightmares of academic confusion, clarify the objectives of the curriculum, and standardize our electrical engineering programs along lines consistent with accepted Gallop Poll opinions as of 1951.

There is nothing sacred about a curriculum, and therefore nothing sacred about an option. Both are set up to facilitate organization, administration and records. No direct educational benefits are derived from either. The curriculum of the very best and the very poorest schools can look exactly the same on paper, just as the menu at the Waldorf could list precisely the entries on the menu at "Joe's Beanery." There is a vast difference between the intellectual nourishment derived from a well organized, competent faculty and that obtained from a weak staff. Yet the curricula in which these staffs operate may be identical. A curriculum, like a menu, is nothing more than a list indicating order of service with no guarantee of quality. A curriculum is not indicative of the quality of the institution, competence of the instructor, adequacy of mental or physical facilities, or a guarantee of a valid education.

The undergraduate curriculum in electrical engineering has been in a continuous state of revision. Some recent revisions undoubtedly resulted in improvements—others are of little consequence or may be detrimental. The surest method of starting a new curriculum is to appoint a new department head. Too frequently administrators resort to *making a change and calling it an improvement.* I, for one, feel that changes in a curriculum without changes in the teaching staff will cause little change in the effectiveness of any program. A curriculum, no matter how well organized, can never be better than the teaching staff that administers it. A perfect listing of undergraduate courses without a competent teaching staff can look good in the catalog, but in reality,

* Presented at A.S.E.E. meeting, East Lansing, Michigan, June, 1951.

it is only an educational ornamentality. Throughout American education there have appeared annually many catch phrases which, through publicity, attract attention. Twenty years ago, this organization was shouting about "creative thinking" and a few of our leading educators seemed to have, in their own opinion, a monopoly on this supposedly novel objective. The rage subsided and we haven't any proof that the whole thing was anything more than an educational ornamentality.

In following years, educators spent much time on the so-called Comprehensive Examinations. Interest in this supposedly novel feature died rapidly when we became aware that such examinations have not contributed greatly to the competence of the graduate and that these examinations were, in many cases, just other educational ornamentalities.

Several years ago, a new crop of curricula sprung up under the name of Engineering Physics. Some of the programs were of high quality. Others consisted only of a common physics program with a maximum of two elementary engineering courses, such as engineering mechanics, inserted in place of some electives. Such programs are not engineering-physics. They are certainly not engineering. While they may look good in the catalog, in reality, they fall into the category of ornamentalities.

I do not wish to imply that all of these innovations and experiments with the curricula have been failures. The cases where they have produced greatest success are undoubtedly those associated with a competent teaching staff. Any program left in the hands of an incompetent faculty results in a failure, regardless of its organization.

Perhaps these comments seem irrelevant to the subject under discussion. They are not intended as such. Neither are they intended to belittle the ideas expressed by other members, present or past, on suggested change in electrical engineering programs. Change is always necessary, and without change, progress is impossible. It should be remembered by all of us that a change does not guarantee improvement; and that the recommendations of A.S.E.E. speakers quite frequently possess a novel appeal, but that they have no enduring value and eventually fall into the class of educational ornamentalities.

The organization of a good teaching staff is far more important that the organization of options. A good faculty is the greatest asset of a university. A poor faculty produces nothing but liabilities—financial and mental. Certain options in a university curriculum may be very successful in institutions where proper staff and facilities are available. If these facilities and educators are not available, any attempt to offer such options will result in nothing more than catalog ornamentalities.

# Report of the Vice President for Instructional Division Activities

It has been customary for the vice president for instructional activities to summarize in his annual report the instructional activities of the past year. His responsibility is stated to be the activities of the Committees and Divisions and he has also been given a general responsibility for the program of the Annual Meeting and for the Summer Schools. However, the Secretary will cover all of the current activities adequately in his report and therefore it seems more useful for your vice president to give his attention to an analysis of the effectiveness of our activities with a view to determining directions for improvement.

### *The Divisions*

The twenty-one Divisions of the Society were first credited with bringing it a new life and were later criticized for having reduced the general interest of the Society in discussions of pedagogy. Both are probably true statements. The growth of the Divisions beginning in the nineteen-thirties coincided with a growth of the Society for which they were doubtless in part responsible. Most engineering teachers have not studied courses in education. Accordingly, their interest in education or pedagogy is directly associated with subject matter. In talking about principles in education they invariably use illustrations from subject-matter fields. Hence, for the mere purpose of communication they choose to group themselves under subject-matter divisions. Thus the original Divisions were born, and in this lies their strength. A few non-subject-matter Divisions such as Cooperative Engineering and Relations with Industry exist for obviously different purposes.

The question to be raised is whether the multiplicity of Divisions should be encouraged or discouraged. The writer was involved in the formation of two Divisions and he recalls vividly the enthusiasm engendered at that time and the heavy attendance at the early sessions sponsored by these Divisions. Despite the doubling of our membership in about a decade, sessions appear to be smaller rather than larger. Attention may be called to the fact that despite a 100 per cent increase in membership the largest meeting held by the Society was not in 1950 or 1951 but was in 1939 at the Pennsylvania State College.

It could be very important to the future of ASEE to re-develop the original enthusiasm created by the formation of the Divisions of the Society. Certainly this cannot be done by discouraging the formation of new Divisions or by eliminating those that exist, although there should be no hesitancy in eliminating any Division that becomes lifeless and unable to conduct its proper activities. The immediate need is to bring the Divisions into the forefront of Society activity and this can be done by working through them in matters of general Society affairs.

As an example of an enlivening influence upon the Divisions let us consider the plan to produce a study or evaluation of engineering education during the next two or three years. It will be a stimulating influence to have the Divisions associated with this study. Since an institutional committee will be appointed on each campus, it is reasonable to assume that each institutional committee will have at least one member who is a mechanical engineer. If these mechanical engineers

who are engaged in the evaluation of engineering education on many campuses can be contacted by the Mechanical Engineering Division, they can be organized within the framework of the Division for active exchange and correlation of information. The same would be true for most Divisions of the Society. The result should be better committee work at the institutional level and a great stimulation of Division activity.

*The Committees*

The Society has two kinds of Committees, standing committees and task committees. Task committees are appointed to accomplish a given task, and as soon as the task can be reasonably accomplished the task committee should be promptly discharged. Rotation of membership is therefore not normal in a task committee. In contrast, a standing committee provides an opportunity for rotation of membership that builds interest and morale in the membership of the Society. Each year all standing committees need to be studied from the viewpoint of their continued usefulness to the Society. Inactive committees are corrosive since the membership considers such appointments to be an undeserved honor. An annual report should be required from every committee to justify its continuation.

*The Summer Schools*

Three or more summer schools have been conducted each summer for the past three years. Before that, a single summer school only was sponsored. The evidence is quite conclusive that the new plan is serving more persons in a very useful manner. The present type of informal summer school is an expansion valve for the annual meeting. Any ambitious group can plan a summer school either in association with or at a different time and place than the annual meeting. The only requirement that needs to be maintained is that the summer school really concern itself with engineering education and not become a research seminar. It must also maintain a balanced budget with a registration fee limited by Council action to $1.50 per day. These regulations have been followed without complaint.

It is believed that the present plan for the conduct of unlimited informal summer schools should be continued and that the Society should leave to the Divisions and Committees the initiative in this matter. The summer conference sponsored by the Committee on "Improvement of Teaching" conducted at Schenectady with Council approval through the cooperation of the General Electric Company is an experiment that will deserve study. Certainly the ASEE desires the closest relations with industry and should invite such cooperative arrangements when the objective is clearly, as in the present instance, a desire on the part of industry to aid in the education of engineers.

*The Annual Meeting*

Those who feel that our Society has lost some of its interest in the discussion of educational problems on a non-subject-matter basis should study the program of the annual meeting. Before the establishment of the ECAC and ECRC three general meetings were frequently devoted to such educational discussions. For the past two years the only part of the program that might be considered to be of this nature has been the President's address and a brief report from the "Committee on Improvement of Teaching."

If the Council should feel seriously about the need for stimulating general discussions of teaching and of engineering education on a non-subject-matter basis, it should decide that a new type of program for the Annual Meeting is in order. Such a program might provide alternate general meetings to those of ECAC and ECRC or it might increase the number of general meetings. A plan by which each morning from Monday through Thursday would be devoted to one or to two nonconflicting general sessions with afternoons and evenings given to the Divisions and Committees would lend a considerably different character to the Annual Meeting.

In this final annual report I wish to ex-

press my appreciation for the opportunity to serve the American Society for Engineering Education during the past two years. Only the officers have the opportunity to observe the time and attention given by so many individuals to the work of the Society. It must be that these individuals consider it to be "their Society" in the best sense of that expression. It is always a pleasure to be a part of such an organization.

Respectfully submitted,

L. E. GRINTER,
*Vice President for Instructional Division Activities*

# Report of Vice President in Charge of Sections and Branches

Sectional activities in the Society have been excellent during the past academic year, and a large portion of the meetings have been attended by various members of your Executive Committee.

As indicated at the Council meeting held at Houston, Texas, shortly before the first of the year, practically all of the Sections have carried the theme of the annual meeting concerning the development of more intimate contact with the faculty of the secondary schools of mathematics and science to encourage more qualified students to enroll in engineering and science. Apparently there have been good results from such a program as there are indications of a definite upturn in enrollment during this past year.

All of the Sections have been alerted to the present as well as the expected shortage of engineers during the next few years, and excellent panels, talks, and other discussions have resulted. The Sections have been encouraged during the past year to increase the participation of younger teachers in the Society, and your officers have found on visits to the schools that excellent work is being done by the young teachers. It is felt that encouragement of this plan is essential in preparing adequate leadership for future years of the Society.

Reports reviewed by the various Sections are stimulating and it is clear that our Society is in excellent shape. Many new members have been enrolled, interest in the Society is spreading rapidly and with continued good leadership, our Sections, wherein lies our real strength, are going to continue to help our Society meet its obligations.

Respectfully submitted,

M. M. BORING,
*Vice President in charge of General and Regional Activities*

# Annual Report of the Engineering College Administrative Council

*Officers and Committees:*

The officers of the Engineering College Administrative Council for the year 1951–52 were: J. H. Lampe, *Chairman*; W. R. Everitt, *Secretary*.

Executive Committee Members were: W. T. Alexander, J. F. Downie Smith, M. A. Durland, H. E. Wessman, and J. H. Davis.

Committee chairmen were: International Relations, L. J. Lassalle; Military Affairs, William Allan; Secondary Schools, W. S. Evans; Selection and Guidance, H. Russell Beatty; Manpower, George D. Lobingier.

*Executive Committee Meetings:*

Three executive committee meetings were held during the year, the first in Houston, Texas, on November 15, and the second and third at the Cornell Club in New York City on January 24, 1952, and on March 7, 1952.

At the Houston meeting, W. L. Everitt was acting-chairman as well as secretary, due to the illness of Chairman J. H. Lampe. Matters discussed included: Professor Bronwell's Japanese Mission; the representation of ASEE in UNESCO; the program for the summer meeting, and organization of an ad hoc committee on relations with secondary schools.

The meeting of January 24 was attended by President Hollister and Secretary Bronwell of ASEE and Vice-president Lampe and Secretary Everitt of ECAC. Progress was made at this meeting on planning the program for the annual meeting at Dartmouth. Other matters discussed included work with secondary schools and guidance and counseling.

At the March meeting a number of activities were dealt with. A nominating committee was appointed to propose a slate for 1952–53 at the June meeting. Committee members included F. E. Terman, *Chairman*, and H. O. Croft and L. E. Seeley. Program details of the June meeting were discussed, and it was decided to limit the number of topics considered, in order to allow sufficient opportunity for full discussion. It was further decided to change the name of the "Closed Session" to "ECAC Session for Institutional Representatives" in order to avoid a wrong impression. No attempt would actually be made to exclude members not institutional representatives. In connection with the ASEE Program of the Year, the Committee explored the possibilities of an ECAC Committee on Junior Colleges and decided to expand the activities of the Secondary Schools Committee to include this phase of activity.

*Projects of the Year:*

The prime interests of the ASEE this year are summarized as follows:

1. Activities which would lead to and bring about scholastic improvement in engineering college programs and in teaching.
2. Activities leading to a fuller understanding of engineering educational programs, especially by means of the cooperation of high school teachers and engineering college teaching and administrative groups.

In order to further these section activities and to carry on overall programs, the ECAC, through its several committees, has carried out programs of study, made recommendations on the subjects concerned,

and developed programs for the national meeting.

*News Bulletins:*

During the past year the ECAC News Bulletin was circulated three times to our institutional, associate, and affiliate members, and to the ASEE officers and council members.

Respectfully submitted,

J. H. LAMPE, *Vice President*
*Engineering College Administrative Council*

# Candid Comments

Secretary
A.S.E.E.
Northwestern University
Evanston, Illinois

Dear Sir:

As the interested mother of a young man who teaches engineering subjects, I often re-read articles in the JOURNAL OF ENGINEERING EDUCATION. I find this a really educational occupation.

Just this morning, in checking over old issues, I find in the April, 1949 issue a most unusual article by T. J. MacKavanagh, Catholic University of America. (I must admit that until this moment I did not note his connection with a religious institution.) The article is entitled "On Pussyfooting."

This article is much too good to be confined to a Journal which the general run of people do NOT see. For many years I have wished that some one would stir up some action of this sort in connection with the so-called institutions of "higher education." Freshmen come in at 17 or 18—most impressionable years—away from home for the first time, and regardless of any previous leaning toward what is called "religious training," they are tossed into classes where they are too often laughed out of any religious feeling. Mr. MacKavanaugh quotes from an article in the September, 1948 JOURNAL, page 10, "Words seem to be lacking to define the exact need we would fill—for we must not call it religion—so let us say an unpledged allegiance to HONOR, which Webster defines. . . ."

I can think of a number of retired teachers—professors emeritus—who could very well devote a part of their retirement to teaching an occasional class (elective) along these same lines. A thoughtful teacher MUST see just what is happening to young people who have no such "unpledged allegiance to honor."

Very truly,

JOSEPHINE SCOTT CAMPBELL,
*Pasadena, California*

# Third National Surveying Teachers' Conference

The Third National Surveying Teachers' Conference was held August 3–8, 1952 at Camp Rabideau, Blackduck, Minnesota under the joint sponsorship of Committee VIII (Surveying and Mapping) of the A.S.E.E. Civil Engineering Division and of the University of Illinois. Delegates from more than fifty colleges of the United States and Canada discussed the teaching of surveying in today's engineering curriculum and heard papers by outstanding surveying teachers and representatives of governmental and private surveying and mapping groups.

E. C. Wagner reported the findings of a nationwide questionnaire survey which showed a breakdown of class hours devoted to various topics in the sequence of surveying courses, a helpful compilation for comparative study. The value of surveying to engineers, civil and non-civil, was affirmed in papers by Norman Porter and R. C. Rautenstraus.

A panel discussion on the requirements and demands for surveying in engineering education was conducted by M. B. Gamet. Panelists were: George H. Harding, Sol A. Baure, Robert C. Johnson, and L. O. Stewart.

The American transit was appraised by R. K. Palmer, and a new type tripod was revealed in a paper by John J. Durkin of the Engineering Research and Development Board to be in the final stages of the development. Sumner B. Irish offered several further areas in surveying that invite research in equipment, procedures, and technique, and urged that such projects be undertaken at once to keep pace with modern science. One such development, the use of electronic surveying equipment, was described by Commander Carl I. Aslakson, U.S.C.G.S. He predicted widespread use of trilateration to replace triangulation within a very few years with a high order of accuracy and with a great saving of time. Photogrammetry, the newest tool of the surveyor, and geodesy, one of the oldest and most necessary, were reviewed and their place in today's curriculum discussed. Papers on photogrammetry were presented by S. H. deJong and Leo V. Nothstine. The paper on geodetic surveying was given by M. O. Schmidt.

One of the more important matters, the teaching of surveying in the classroom and in the field, occupied the conferees during a day-long session. Audio-visual teaching aids was the subject of a paper by Kenneth S. Curtis, and Alfred C. Stiefel, speaking on "Ten Thousand Maps at Your Service," urged the teachers to acquaint surveyors and engineers with these available maps and demonstrate their great utility in solving many everyday problems. Excellent ideas were contributed to the subject of field instruction by Otto S. Zelner, while Fred J. Spry detailed the several methods in use throughout the nation's schools for the storage, handling, and care of surveying instruments and equipment. Many ideas were exchanged in the session devoted to field techniques conducted by Carl A. Egner.

The papers of the Third National Conference will shortly be published in a bound volume and may be procured from Professor Sumner B. Irish, Editor, at Princeton University at nominal cost.

# Section Meetings

| *Section* | *Location of Meeting* | *Dates* | *Chairman of Section* |
|---|---|---|---|
| *Allegheny | West Virginia University | | C. H. Cather, West Virginia University |
| Illinois-Indiana | Rose Polytechnic Institute | May, 16, 1953 | H. A. Moench, Rose Polytechnic Institute |
| Kansas-Nebraska | University of Kansas | Oct. 24–25, 1952 | M. A. Durland, Kansas State College |
| Michigan | Detroit Institute of Technology | May 9, 1953 | C. C. Winn, Detroit Institute of Technology |
| Middle Atlantic | Manhattan College | December 6, 1952 | W. B. Plank, Lafayette College |
| Missouri | Washington University | April 11, 1953 | G. F. Branigan, University of Arkansas |
| National Capital Area | Catholic University of America | Oct. 7, 1952 | L. K. Downing, Howard University |
| | Howard University | May 9, 1953 | |
| | University of Maryland | Feb. 3, 1953 | |
| New England | Worcester Polytechnic Institute | Oct. 18, 1952 | E. T. Donovan, University of New Hampshire |
| North Midwest | Iowa State College | Oct. 3–4, 1952 | S. J. Chamberlin, Iowa State College |
| *Ohio | University of Cincinnati | April, 1953 | H. K. Justice, University of Cincinnati |
| *Pacific Northwest | Washington State College | Spring, 1953 | J. P. Spielman, Washington State College |
| Pacific Southwest | California State Polytechnic College | Dec. 29–30, 1952 | C. E. Cherry, College of Marin |
| *Rocky Mountain | University of Wyoming | April 19, 1952 | C. A. Hutchinson, University of Colorado |
| *Southeastern | Louisiana State University | March, 1953 | D. V. Terrell, University of Kentucky |
| Southwestern | University of New Mexico | April 3 & 4, 1953 | M. L. Ray, University of Houston |
| Upper New York | Alfred University | October 10–11, 1952 | R. M. Campbell, Alfred University |

**Members of the Society are welcome at all Section Meetings**

* No Date Set.

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**Atomic Energy Education:** For three years: L. M. K. Boelter, G. H. Hawkins; for two years: H. B. Hansteen, H. E. Wessman; for one year: H. H. Armsby, R. C. Ernst. Secretary: A. F. Thompson, AEC.

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**Engineering Economy:** H. S. Osborne, *Chairman*, American Telephone & Telegraph Co., New York, N. Y., J. M. Apple, E. D. Ayres, J. C. Gebhard, E. M. Griswold, A. R. Gruehr, A. Lesser, J. F. Manildi, K. B. McEachron, Jr., W. D. McIlvaine, S. J. Montgomery, W. R. Spriegel, H. G. Thuesen, J. E. Vivian.

**Engineering School Libraries:** George Bonn, *Chairman*, The Rice Institute, Houston, Texas, J. E. Allerding, C. W. Bennett, W. S. Budington, E. A. Chapman, W. R. Harvey, Wm. Hyde, P. Leslie, C. Penrose, M. Ritchie, H. E. Sauter, V. D. Tate, I. A. Tumbleson.

**Ethical Standards, Promotion of:** C. J. Freund, *Chairman*, University of Detroit, Detroit, Mich., N. A. Christensen, N. W. Dougherty, E. F. Obert.

**Evaluation of Engineering Education:** L. E. Grinter, *Chairman*, University of Florida, Gainesville, Fla., H. H. Armsby, L. M. K. Boelter, A. P. Colburn, C. S. Crouse, J. P. Den Hartog, N. W. Dougherty, T. H. Evans, W. L. Everitt, R. C. Ernst, M. G. Fontana, D. F. Gunder, J. F. Gregg, G. A. Hawkins, S. C. Hollister, J. A. Hrones, L. H. Johnson, J. Marin, G. Murphy, M. P. O'Brien, R. L. Pigford, D. H. Pletta, R. S. Poor, J. H. Rushton, H. Rouse, T. Saville, H. H. Skilling, A. F. Spilhaus, R. L. Sweigert, R. B. Teare, E. A. Walker, E. Weber, H. E. Wessman, C. L. Wilson, A. Wolman, W. R. Woolrich, D. Young, A. B. Bronwell.

**Financial Policy:** F. M. Dawson, *Chairman*, State University of Iowa, Iowa City, Iowa, S. C. Hollister, Thorndike Saville, C. L. Skelley.

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**Publication:** A. B. Bronwell, *Chairman*, Northwestern University, Evanston, Ill., S. C. Hollister, C. L. Skelley, James S. Thompson, C. E. Watson, W. R. Woolrich.

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**American Council on Education:** H. T. Heald, S. C. Hollister (1955); H. S. Rogers, Thorndike Saville (1954); A. B. Bronwell, F. L. Hovde (1953).

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**American Standards Association:**

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**Y10—Symbols and Abbreviations:** W. A. Lewis, *Chairman*, T. C. Hanson, P. J. Kiefer, W. B. Plank, M. C. Stuart, C. C. Whipple.

**Sub-Committee Z10.4–1943—Letter Symbols for Heat and Thermodynamics:** B. E. Short, H. L. Solberg, M. C. Stuart.

**Y14—Drawings and Drafting Room Practice:** H. C. Spencer, *Chairman*, F. G. Higbee, R. P. Hoelscher, W. J. Luzadder, R. S. Paffenbarger. C. L. Svenson, C. J. Vierck.

**Y15—Graphic Presentation:** R. S. Paffenbarger, *Chairman*, D. P. Adams, A. S. Levens, R. O. Loving.

**Y32—Graphical Symbols and Drawings:** I. L. Hill, *Chairman*, J. G. McGuire, R. T. Northrup.

**A62—Coordination of Dimensions of Building Materials and Equipment:** R. A. Caughey.

**C61—Electric and Magnetic Magnitudes and Units:** Harold Pender, C. V. O. Terwilliger, C. F. Rehberg.

**Charles A. Coffin Fellowships and Research Committee:** W. R. Woolrich.

**Educational Testing Service—Advisory Council:** H. R. Beatty, *Chairman*, J. F. Calvert, N. W. Dougherty.

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**International Relations Committee:** L. J. Lassalle, S. S. Steinberg.

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**National Bureau of Engineering Registration:** C. L. Eckel.

**National Research Council:** G. A. Rosselot (June, 1953).

**National Science Foundation—Committee on International Exchange of Students:** S. S. Steinberg.

**National Science Teachers Association—Future Scientists and Engineers of America:** H. R. Beatty.

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BIECK, WALTER H., Associate Professor of Drafting, Milwaukee School of Engineering, Milwaukee, Wis. R. J. Ungrodt, F. Kaufmann.

BRIGGS, WILLIAM W., Assistant Professor of Air Transportation, Purdue University, Lafayette, Ind. N. Little, P. E. Stanley.

BROWN, JULIUS, Instructor in Engineering, St. Louis University, St. Louis, Mo. V. J. Blum, J. B. Macelwane.

CADY, JOSEPH G., Instructor in Mechanical Engineering, Syracuse University, Syracuse, N. Y. D. U. Greenwald, B. H. Norem.

CHIRLIAN, PAUL M., Instructor in Electrical Engineering, New York University, New York, N. Y. P. Greenstein, T. Torgersen.

CONNELL, JOHN B., Instructor in Engineering, St. Louis University, St. Louis, Mo. V. J. Blum, J. B. Macelwane.

CURTIS, ROZEL E., Staff Assistant, Technical Personnel, General Electric Co., Schenectady, N. Y. D. W. McLenegan, T. S. Marshall.

DOBBINS, WILLIAM E., Associate Professor of Sanitary Engineering, New York University, New York, N. Y. W. T. Ingram, T. Saville.

DRAPER, ALAN B., Instructor in Industrial Engineering, Syracuse University, Syracuse, N. Y. D. U. Greenwald, B. H. Norem.

DUNLAP, EUGENE W., Instructor in Engineering, St. Louis University, St. Louis, Mo. V. J. Blum, J. B. Macelwane.

FENNELLY, DENNIS M., Professional Placement Supervisor, Burroughs Adding Machine Co., Philadelphia, Pa. H. E. Tompkins, I. Travis.

GOODMAN, C. J., Instructor in Engineering, Detroit Institute of Technology, Detroit, Mich. L. L. Henry, E. A. Lucitte.

GRUEHR, ANATOLE R., Adjunct Professor of Economics, Polytechnic Institute of Brooklyn, N. Y. H. F. Roemmele, A. Lesser, Jr.

GUMPERTZ, WERNER H., Assistant Professor of Building Engineering and Construction, Massachusetts Institute of Technology, Cambridge, Mass. W. C. Voss, J. T. Rule.

HINKLE, WALTER C., Assistant Director, N. Y. State Agricultural & Technical Institute, Alfred, N. Y. G. S. Whitney, R. M. Campbell.

IERARDI, GORDON S., Associate Editor, John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. W. B. Wiley, W. G. Stone.

KELLY, SIDNEY J., Head, Diesel Technology, N. Y. State Agricultural & Technological Institute, Alfred, N. Y. G. S. Whitneym R. M. Campbell.

KLINE, JACOB, Assistant Professor of Electrical Engineering, University of Rhode Island, Kingston, R. I. R. H. Frazier, C. E. Tucker.

KNUDSEN, JOHN R., Assistant Professor of Mathematics, New York University, New York, N. Y. H. A. Giddings, G. A. Yanosik.

KOLSTAD, CHARLES K., Instructor in Diesel Technology, N. Y. State Agricultural & Technical Institute, Alfred, N. Y. G.S. Whitney, R. M. Campbell.

LANE, JOHN D., Professor of English, Clemson, S. C. J. H. Sams, J. L. Edwards.

LAWLOR, JAMES J., Instructor in Machine Design, Stevens Institute of Technology, Hoboken, N. J. M. R. Reeks, N. J. Rose.

LINGO, LOWELL E., Instructor in Electrical Engineering, Syracuse University, Syracuse, N. Y. D. U. Greenwald, B. H. Norem.

LIPPERT, FREDERICK G., Director of Personnel, American Gas and Elec. Service Corp., New York, N. Y. D. S. Roberts, F. D. Leamer.

LOBDELL, LEON W., Instructor in Industrial Engineering, N. Y. State Agricultural &

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LONG, RALPH H., JR., Associate Professor of Mechanical Engineering, University of Maryland, College Park, Md. J. E. Younger, M. S. Ojalvo.

MCGOWAN, JOHN P., Engineering Librarian, New York University, New York, N. Y. F. K. Teichmann, A. H. Church.

MEIXNER, HENRY N., Assistant Director, Machine Develop. Section, E. I. duPont de Nemours & Co., Inc., Wilmington, Dela. T. H. Chilton, R. E. Burton.

MULLIGAN, JAMES H., JR., Associate Professor of Electrical Engineering, New York University, New York, N. Y. H. Torgersen, P. Greenstein.

PAGE, GEORGE N., Assistant Professor of Engineering Drawing, Syracuse University,, Syracuse, N. Y. D. U. Greenwald, B. H. Norem.

PANTER, HAROLD J., Instructor in Electrical Engineering, N. Y. State Agricultural & Technical Institute, Alfred, N. Y. G. S. Whitney, R. M. Campbell.

PARKER, JAY B., Assistant Professor of Civil Engineering, Rensselaer Polytechnic Institute, Troy, N. Y. H. O. Sharp, R. K. Palmer.

PATNODE, WINTON I., Assistant to General Manager, Nucleonics Division, General Electric Company, Richland, Wash. D. W. McLenegan, T. S. Marshall.

PATCHEN, LEWIS W., Instructor in Industrial Engineering, N. Y. State Agricultural & Technical Institute, Alfred, N. Y. G. S. Whitney, R. M. Campbell.

RENNER, JOHN H., Instructor in Electrical Engineering, N. Y. State Agricultural & Technical Institute, Alfred, N. Y. G. S. Whitney, R. M. Campbell.

RISING, EDWARD J., Instructor in Mechanical Engineering, Syracuse University, Syracuse, N. Y. D. U. Greenwald, B. H. Norem.

RITTER, LEO J., JR., Associate Professor of Civil Engineering, University of Florida, Gainesville, Fla. T. L. Bransford, W. H. Zimpfer.

ROCKEY, CHARLES F., Instructor in Electrical Engineering, Milwaukee School of Engineering, Milwaukee, Wis. F. J. Van Zeeland, F. H. Kaufmann.

SCOTT, MARION B., Associate Professor in Structural Engineering, Purdue University, West Lafayette, Indiana. P. E. Soneson, J. M. Hayes.

SHORE, SIDNEY, Assistant Professor of Civil Engineering, Princeton University, Princeton, N. J. J. C. Elgin, E. J. Johnson, Jr.

SMITH, STANLEY L., Assistant Professor of Mathematics, U. S. Coast Guard Academy, New London, Conn. R. J. Perry, E. P. Rivard.

STARTZ, ARTHUR, Instructor in the Humanities (Economics), The Cooper Union, New York, N. Y. H. F. Roemmele, W. S. Watson.

STOLL, CHARLES B., Associate Editor, John Wiley & Sons, Inc., 440 Fourth Ave., New York, N. Y. W. B. Wiley, W. G. Stone.

STREAT, WILLIAM A., Jr., Professor of Architecture, A. & T. College of North Carolina, Greensboro, N. C. J. M. Marteena, L. K. Downing.

TONG, KIN NEE, Assistant Professor of Mechanical Engineering, Syracuse University, Syracuse, N. Y. D. U. Greenwald, B. H. Norem.

WAGNER, GLENN B., General Technical Services, General Electric Company, Schenectady, N. Y. M. M. Boring, C. F. Lee.

WALSH, GERALD W., JR., Instructor in Engineering Drawing, Syracuse University, Syracuse, N. Y. D. U. Greenwald, B. H. Norem.

WERNER, JULIUS M., Instructor in Mechanical Engineering, Syracuse University, Syracuse, N. Y. D. U. Greenwald, B. H. Norem.

WILLIAMS, EUGENE R., Instructor in Engineering, Bradford Durfee Technical Institute, Fall River, Mass. G. H. MacCullough, A. J. Ferretti.

WINN, WILLIAM C., Instructor in Electrical Engineering, Milwaukee School of Engineering, Milwaukee, Wis. H. D. Werwath, S. A. Eng.

ZABORSZKY, JOHN, Professor of Electrical Engineering, Missouri School of Mines, Rolla, Mo. J. W. Rittenhouse, I. H. Lovett.

133 new members elected this year

# Divisions, 1952–53*

AERONAUTICAL: K. E. Smith, *Chairman*, University of Detroit; A. J. Fairbanks, *Vice Chairman;* L. Z. Seltzer, *Secretary.*

AGRICULTURAL: Orval C. French, *Chairman*, Cornell University; R. H. Driftmier, *Vice Chairman;* F. B. Lanham, *Secretary.*

ARCHITECTURAL: P. E. Soneson, *Chairman*, Purdue University; J. E. Varga, *Vice Chairman.*

CHEMICAL: N. H. Ceaglske, *Chairman*, University of Minnesota; R. K. Toner, *Vice Chairman;* R. W. Moulton, *Secretary;* A. H. Cooper, Editor.

*Civil Engineering*: F. W. Stubbs, Jr., *Chairman*, Purdue University; A. J. McNair, *Vice Chairman;* W. J. Eney, *Secretary;* M. B. Scott, *Editor, CE Bulletin; Directors:* C. L. Barker, J. W. Hubler, R. L. Peurifoy.

COOPERATIVE ENGINEERING EDUCATION: H. C. Messinger, *Chairman*, Univ. of Cincinnati; M. Robinson, *Vice Chairman;* W. Thomas, *Secretary.*

EDUCATIONAL METHODS: A. P. Colburn, *Chairman*, University of Delaware; R. L. Sweigert, *Vice Chairman;* E. Kraybill, *Secretary.*

ELECTRICAL: H. E. Hartig, *Chairman*, Univ. of Minnesota; L. V. Bewley, *Vice Chairman;* J. N. Thurston, *Secretary.*

ENGINEERING DRAWING: J. J. Gerardi, *Chairman*, Univ. of Detroit; R. T. Northrup, *Vice Chairman;* J. G. McGuire, *Secretary; Executive Committee:* R. P. Hoelscher, C. Springer, Wm. Street, C. E. Rowe, H. E. Grant, J. S. Rising; W. J. Luzadder, *Editor;* J. M. Russ, *Editor, T-Square;* E. M. Griswold, *Circulation Manager.*

ENGLISH: A. M. Fountain, *Chairman*, North Carolina State College; C. R. Davis, *Vice Chairman;* W. M. Keck, *Secretary.*

EVENING ENGINEERING EDUCATION: R. W. Van Houten, *Chairman*, Newark College of Engineering; W. D. McIlvaine, Jr., *Vice Chairman;* C. E. Schaffner, *Secretary.*

GRADUATE STUDIES: N. A. Christensen, *Chairman*, Cornell University; H. L. Hazen, *Vice Chairman;* R. G. Folsom, *Secretary; Executive Committee:* G. B. Headley, H. E. Wessman, D. F. Peterson, J. H. Rushton, E. M. Williams, C. O. Harris.

HUMANISTIC-SOCIAL DIVISION: D. G. Stillman, *Chairman*, Clarkson College; S. P. Olmsted, *Vice Chairman.*

INDUSTRIAL ENGINEERINGS W. G. Ireson, *Chairman*, Stanford University; F. F. Groseclose, *Vice Chairman;* B. H. Norem, *Secretary;* B. H. Norem, *Editor.*

MATHEMATICS: C. V. Newsom, *Chairman*, State Education Dept., Albany, N. Y.; J. H. Zant, *Secretary;* J. H. Zant, *Editor; Executive Committee:* H. M. Gehman, W. H. Krathwohl, C. R. Wylie.

MECHANICAL ENGINEERING: E. L. Midgette, *Chairman*, Brooklyn Polytechnic Institute; E. E. Ambrosius, *Vice Chairman;* I. W. Smith, *Secretary;* K. P. Hanson, *Editor, Head Power;* L. F. Kreisle, *Editor, Machine Design and Manufacturing.*

MECHANICS: D. H. Pletta, *Chairman*, Virginia Polytechnic Institute; G. Murphy, *Editor; Executive Committee:* W. B. Stiles, H. R. Lissner, W. M. Lansford, R. G. Sturm, A. L. Miller, G. Murphy, J. Marin, F. L. Singer, D. H. Pletta.

MINERAL EDUCATION ENGINEERING: J. R. Cudworth, *Chairman*, University of Alabama; W. J. Rundle, *Vice Chairman;* Wm. Chedsey, *Secretary.*

PHYSICS: G. P. Brewington, *Chairman*, Lawrence Institute of Technology; R. Seeger, *Vice Chairman;* George Burnham, *Secretary.*

RELATIONS WITH INDUSTRY: G. D. Lobingier, *Chairman*, Westinghouse Electrical Corp., East Pittsburgh, Penna.; J. A. Gammell, *Vice Chairman;* G. K. Dreher, *Secretary.*

TECHNICAL INSTITUTE: L. F. Smith, *Chairman*, Rochester Institute of Technology; L. Rouillion, *Vice Chairman;* K. Werwath, *Secretary.*

* Representatives on General Council listed on Officer's Page.

# Sections, 1952–53*

ALLEGHENY: I. W. Short, *Vice Chairman;* A. L. Reed, *Secretary.*

ILLINOIS-INDIANA: R. G. Owens, *Vice Chairman;* O. M. Knudsen, *Secretary; Executive Committee:* I. P. Hooper, L. D. Groves, G. V. Muller, D. H. Dahlstrom, F. I. Fiesenheiser, M. S. Peters.

KANSAS-NEBRASKA: L. O. Hanson, *Vice Chairman;* A. R. LeGault, *Secretary.*

MICHIGAN: F. L. Schwartz, *Vice Chairman;* C. C. Sigerfoos, *Secretary; Executive Committee:* L. R. Baker, G. P. Brewington, A. L. Hellwarth.

MIDDLE ATLANTIC: A. W. Luce, *Vice Chairman;* H. S. Bueche, *Secretary.*

MISSOURI: F. H. Conrad, *Vice Chairman;* R. C. Johnson, *Secretary.*

NATIONAL CAPITAL AREA: C. H. Walther, *Vice Chairman;* D. C. Jackson, Jr., *Secretary.*

NEW ENGLAND: E. F. Littleton, *Secretary.*

NORTH MIDWEST: A. B. Drought, *Vice Chairman;* Wm. C. Alsmeyer, *Secretary; Executive Committee:* E. P. Wiedenhoefer, A. B. Cambel, C. O. Anderson, W. H. Camble, M. H. Chedrick, O. W. Potter, T. J. Higgins.

OHIO: E. O. Scott & N. D. Thomas, *Vice Chairmen;* K. F. Sibila, *Secretary.*

PACIFIC NORTHWEST: R. K. Reynolds, *Vice Chairmen;* L. D. Luck, *Secretary.*

PACIFIC SOUTHWEST: C. E. Knott, *Vice Chairman;* J. B. Franzini, *Secretary.*

ROCKY MOUNTAIN: A. Diefendorf, *Vice Chairman;* K. H. Stahl, *Secretary.*

SOUTHEASTERN: J. R. Cudworth, *Vice Chairman;* B. M. Bayer, *Secretary.*

SOUTHWESTERN: J. J. Heimerich, *Vice Chairman;* T. T. Castonguay, *Secretary.*

UPPER NEW YORK: B. H. Norem, *Vice Chairman;* A. D. Taylor, *Secretary.*

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*Chairmen listed on Section Meetings Page, Council Representatives listed on Officer's Page.

# Minutes of Executive Board Meeting

A meeting of the Executive Board of the American Society for Engineering Education was held on Thursday, September 4, 1952, at the Drake Hotel, Chicago, Illinois. Those present were: W. R. Woolrich, *President;* M. M. Boring, J. H. Lampe, E. A. Walker, W. C. White, *Vice Presidents;* C. L. Skelley, *Treasurer;* A. B. Bronwell, *Secretary;* C. E. Watson, *Assistant Secretary;* M. C. Merrill, *Office Secrtary.*

*Report of Secretary*

a) *Committee appointments*

A list of new committee members was presented. Nominees for committee appointments had previously been obtained from Committee Chairmen. Members of the Executive Board were asked to review the list and submit recommendations for additions.

b) *Membership activities*

The membership drive this year will be organized largely by Institutions with a chairman in each engineering college. Emphasis will be placed upon expanding the membership among the younger faculty members in engineering colleges. The Division of Relations with Industry will be approached to suggest prospective members from industry.

c) *Advertising in Journal*

The Assistant Secretary has started a promotional campaign to increase advertising in the JOURNAL OF ENGINEERING EDUCATION, in order to obtain additional revenue for Society operations. Several hundred letters have been mailed to prospective advertisers and key individuals in various companies are being contacted.

A discussion of the advertising rates indicated that they are low in comparison with similar journals. It seemed inadvisable to increase advertising rates at this time, because the present rates have been announced in the promotional letters. The Executive Board voted to increase the JOURNAL advertising rates as of January 1, 1954, the new rates to be recommended to the Board by a commitee consisting of C. L. Skelly (Chairman), M. M. Boring, and C. E. Watson.

*Report of Treasurer*

*Annual Audit*

Treasurer Skelley reported to the Executive Board on the Annual Audit and specifically the Comparative Statement of Income and Expense for the twelve months ending June 30, 1951, and the twelve months ending June 30, 1952. The Executive Board also reviewed the budget for 1952–53.

*Air Force ROTC Program*

Dean Lampe reported on the special executive committee meeting of the ECAC on September 4th with officers of the Air Force ROTC program, including General Deichelmann, who is in charge of this program. The Air Force ROTC curriculum will be altered by the introduction of a general curriculum for all college students. This curriculum will not contain specialties, such as those given in previous Air Force ROTC programs. He stated that considerable attention was given at this meeting to the problem of the proper assignment by the ROTC of graduates who have received their training in engineering.

*Recommendations of Coordinating Committee on Relations With the Federal Government*

The Executive Board discussed the recommendation of the Coordinating Committee on Relations With the Government

to the effect that increased attention be given to the adequate placement of engineering graduates who are completing their military service. Vice President Boring stated that in many detachment centers, no organized procedure has been developed for the placement of such graduates and many of them are either accepting sub-professional work or are returning to military service or non-technical jobs because of inability to get adequate placement. Mr. Boring pointed out that the interviewing procedures set up at most of the detachment centers are entirely inadequate and sometimes unethical. He stated that the company representatives in their interviewing are compelled to use seriously crowded quarters and to abide by an interviewing schedule which is hopeless from the standpoint of getting effective results.

It was recommended that engineering deans call attention of the graduating seniors to both the placement service in the college and the Engineering Societies Placement Service, and urge those who go into the military services to contact these placement services before military detachment. President Woolrich will call this to the attention of the Society by means of a Presidential News Letter.

*Future Annual Meetings*

Secretary Bronwell stated that Cornell University had formally withdrawn its invitation to the Society for the 1955 Annual Meeting, in order to make it possible to hold this meeting at Pennsylvania State College, since this would coincide with the Centennial year at Pennsylvania State. The Executive Board voted to hold the 1955 Annual Meeting at Pennsylvania State College.

*Plans for Annual Meeting at the University of Florida*

It was recommended that there be three general sessions on Tuesday, Wednesday and Thursday mornings, as in the past, with one of these a general session of the Society and the other two sponsored by ECRC and ECAC. It was recommended that the general sessions start at 9:30 A.M., rather than 9:00 A.M. and that the program should be of more limited duration than last year. Secretary Bronwell stated that a new committee consisting of Drs. J. R. Killian, H. T. Heald, and A. S. Adams had been appointed to make recommendations for program material for the A.S.E.E. general session and banquet.

There was a discussion as to whether or not attempt should be made to implement the recommendations of the Barlow Committee Report in the Annual Meeting for 1953. It was decided to await recommendations of the Committee on Society Functions before proceeding in this matter. President Woolrich suggested that the University of Florida consider plans for commemorating the 60th Anniversary of the A.S.E.E.

The Executive Board expressed the opinion that most Divisions and Committees have a tendency to schedule too many conferences, resulting in numerous conflicts. Also, it was pointed out that several Divisions have tried a workshop type of program in which all participants discuss a planned program, but in which there are no scheduled speakers. These workshop programs have proven highly successful, since they increase the audience participation and often bring forth a more interesting treatment of the subject material than those containing prepared papers. It was suggested that the Divisions consider allotting more time for discussions of this character on some of their important problems.

*Improvement of Journal of Engineering Education*

Assistant Secretary Watson reported on the status of the JOURNEL OF ENGINEERING EDUCATION and presented suggestions which were being considered for improvement. It has been suggested that a few more articles of broad general interest to the Society membership at large, perhaps not dealing specifically with engineering education, but with subjects which are of vital interest to engineering

educators would improve the interest value of the JOURNAL.

*Institutional Membership*

Upon application from Bradley University, the Executive Board voted to change the status of this University from Affiliate member to Active member.

Secretary Brownell stated that Mr. McKeon is developing material for publicizing the Associate Institutional Membership possibilities among industries of the country.

*Other Items of Business*

In addition to the foregoing items, the Executive Board considered the following items, the recommendations of which are summarized in the General Council Minutes of September 4, 1952.

a. Reports of Vice Presidents;
b. Committee on Recognition and Incentives for Good Teaching;
c. Committee on Promotion of Ethics in Engineering Colleges;
d. Teaching position advertisements in the Journal;
e. Paper contest for young engineering teachers.

Respectfully submitted,
ARTHUR B. BRONWELL,
*Secretary*

*Reserve this date . . . .*

**June 22-26, 1953**

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**ANNUAL MEETING**

**UNIVERSITY OF FLORIDA**
**GAINESVILLE, FLORIDA**

# Minutes of General Council Meeting

A meeting of the General Council of the American Society for Engineering Education was held Thursday, September 4, 1952, at the Drake Hotel, Chicago, Illinois. Those present were: W. R. Woolrich, *President;* M. M. Boring, J. H. Lampe, E. A. Walker, W. C. White, *Vice Presidents;* C. L. Skelley, *Treasurer;* A. B. Bronwell, *Secretary;* C. E. Watson, *Assistant Secretary;* M. Merrill, *Office Secretary;* W. Allan, H. H. Armsby, R. M. Boarts, C. A. Brown, F. M. Dawson, K. B. McEachron, Jr., W. L. Everitt, C. J. Freund, W. P. Godfrey, L. E. Grinter, C. O. Harris, H. E. Hartig (substituting for T. H. Morgan), D. C. Hunt, E. Hutchisson, H. Keunzel, E. F. Obert, R. S. Paffenbarger, Thorndike Saville, E. Weber, K. F. Wendt, K. O. Werwath, C. L. Wilson, S. E. Winston.

*Report of Secretary*

The Secretary presented lists of new committee appointments and requested that additional suggestions from members of the Council be sent to either President Woolrich or the Secretary.

Professor Watson, the Assistant Secretary, briefly reviewed the advertising situation and stated that although the advertising rates in the Journal are considerable lower than similar publications, the Executive Board had decided not to raise the rates until January, 1954, since a campaign has been started to increase the volume of advertising in the JOURNAL.

*Report of Treasurer*

The Treasurer presented the final Audit for 1951–52 and discussed the Comparative Statement of Income and Expense. The Audit showed an excess of income over expense of $4,268.48 after having transferred $6,004.69 to the ECRC reserve. The latter transfer was voted by the Executive Board in June in order to establish a reserve fund which would even out the fluctuations in expense of the ECRC from year to year, owing to its cyclic publication schedule. The Secretary explained the 1952–53 budget. The income anticipates increases in revenue from increased membership, expansion of advertising in the JOURNAL, and expansion of the Associate Institutional Memberships in the Society. The budgeted expense makes provision for more time on the part of the Secretary and Assistant Secretary for A.S.E.E. business and also provides for salary increases of the office staff which were voted by the Executive Board on June 23. The expansion of Secretarial staff time will facilitate carrying on a campaign for increased advertising in the JOURNAL and provide for a general expansion of Society activities and better coordination of activities with other societies.

*Report of Vice Presidents*

Dean Walker reported on the ECRC activities, stating that a new secretary, Professor Virgil Neilly, of Pennsylvania State College, had been engaged. He commended highly the work of the previous secretary, John Mattill. The ECRC Committees have been appointed and the planning for the year's activities is now under way. The ECRC aranged for a program "The Engineer is a Scientist" for the Centennial Symposium in Chicago. The Committee on Contractural Relations With the Government is preparing a handbook dealing with relations with Government agencies in contractural research relationships. The ECRC also contemplates publication of a Review of Current Research during the coming year.

Vice President Boring announced the rules of the paper contest for young en-

gineering teachers. He will write Section officers, outlining the plan and urging them to give this matter widespread publicity.

Dean White stated that he is writing to chairmen of Divisions and Committees, recommending that they get started immediately in planning their Annual Meeting programs and also suggesting certain considerations, such as fewer conferences, more discussion time at the conferences, and better planned programs. He will also bring to their attention the need for advanced planning on any ASEE sponsored summer schools which the Divisions might propose.

Vice President Lampe reported that the Engineering Manpower Committee of the Society is under the chairmanship of Donald Bridgman, who will also be a member of the Engineering Manpower Commission. It was hoped that this arrangement would provide a closer liaison in manpower problems than has existed in the past. He also reported that the ASEE's program of Cooperation Between Engineering Colleges and Secondary Schools, which was started last year, is under the chairmanship of Dean Pierce of the University of Illinois. The Committee on International Relations will be headed by Dean Steinberg and the Committee on Selection and Guidance by Dean N. W. Dougherty.

*Committee on Recognition and Incentives for Good Teaching*

President Woolrich stated that the Committee on Improvement of Teaching of the ASEE had just completed a highly commendable report on this subject, copies of which would be made available at cost in any quantity desired to engineering colleges for distribution among their faculty members. However, he stated that there is another phase of this problem which was not within the scope of the committee's study, but which is highly important from the standpoint of improving the quality of education in engineering colleges. There is a growing trend among teachers in engineering colleges to place great emphasis upon research accomplishments, consulting, and contributions to technical literature. While these objectives are highly commendable, they often result in a general deterioration in the quality of teaching, since a number of teachers are inclined to devote a disproportionately large amount of their time to these secondary activities. He recommended that consideration be given by the ASEE to the appointment of a committee to study means of providing recognition and incentives for commendable teaching, in order to encourage faculty members to give greater consideration to this primary function. In the discussion of this problem it was pointed out that the situation is one which is generally recognized by faculty members and administrators alike, but no serious attempt has been made to evaluate the problem or to recommend administrative practices for alleviating the difficulty. The Executive Board voted to authorize appointment of such a committee, to report to the General Council of the Society.

*Committee on Promotion of Ethics in Engineering Colleges*

The decline of ethical standards in engineering practice is a subject of great importance which has been called to the attention of educators and the Society on innumerable occasions. The teaching of ethical precepts of the engineering profession is given very little attention in most engineering colleges. A number of professional engineers have expressed the opinion that engineering colleges are lax in their recognition of responsibility in this regard. It was suggested that the teaching of ethics should be woven into all of the engineering courses, rather than set aside as separate instruction. The General Council recommended that a committee on Promotion of Ethics in Engineering Colleges be appointed, with the request that it prepare a report recommending various types of programs which the colleges could consider.

*Paper Contest for Younger Faculty Members*

A suggested set of rules for conduct of the paper contest for young engineering faculty members was considered by the Executive Board and General Council and adopted. The purpose of the paper contest is to stimulate original thinking on the part of younger faculty members in engineering colleges and encourage their active participation in Society problems. Previously, the General Council had voted to authorize two prizes of $200 and $100 for the two prize winning papers. Each Section of the ASEE would announce the competition among the younger faculty members within its jurisdiction in order to encourage participation and would establish a procedure for judging the papers and submitting the winning entries to ASEE Headquarters. The awards will be presented at the Annual Banquet, along with the Lamme Award and the George Westinghouse Award. The rules for the paper contest are as follows:

a. Open to all members of ASEE under 36 years of age.
b. Subject of paper contest will be announced by the President of the ASEE.
c. Papers should not exceed 3,000 words in length.
d. All entrees should be submitted to the officers of the ASEE Section in which the participant resides.
e. Each Section of the ASEE will appoint its own judging committee, formulate its own rules, and select one winning paper for submission to ASEE Headquarters.
f. A national judging committee will select the winning papers.
g. The awards will be $200 for first place and $100 for second place, with appropriate certificates.

*Conference of ECAC on ROTC Plans*

Dean Allan, reporting for the Military Affairs Committee of the ECAC, stated that considerable attention had been given by his committee to the problem of the disposition of ROTC graduates by the Army and Air Force after graduation. According to present practice, a graduate whose primary field of classification is filled is permitted to accept civilian employment until his primary field is open. There is considerable question among engineering educators as to whether this desirable condition will prevail of the ROTC programs are altered and the technical training courses are replaced by general courses. The following resolution was presented by Deans Saville, Grinter and Lampe:

"That the Council of ASEE believes that the acceptance of the proposed general programs of Army-ROTC and of Air Force-ROTC with the abandonment of the long-established professional branches such as Signal Corps, Engineering Corps, Ordnance, Chemical Warfare and corresponding specialties in the Air Force will reduce the number of engineering trained Cadet Officers so badly needed by the military services and will also increase the deficit of engineers required for the industrial effort associated with national defense production due to the diversion of engineering ROTC graduates to military services where their engineering capabilities are not fully utilized.

"The Council of ASEE therefore recommends to the administrators of institutions teaching engineering that acceptance of any changes involving possible abandonment of the existing professional Army-ROTC and Air Force-ROTC branches be deferred pending immediate conferences of the officers of the Society with the proper representatives of the Military Services and subsequent report to the Institutions involved."

The Counicl approved this resolution with the request that it be sent to Presidents of Colleges, with copies to the Engineering Deans and also to the proper officials in charge of Army and Air Force ROTC programs.

*Teaching Position Advertisements in Journal of Engineering Education*

A questionnaire sent to members of the General Council and deans of engineering colleges inquired as to their recommendations regarding the possibility of including in the JOURNAL OF ENGINEERING EDUCATION advertisements of teaching positions. This yielded the following results: 71 persons favored inclusion of such advertisements, 11 opposed; 60 persons favored including advertisements of individuals seeking positions, and 44 opposed; 25 persons favored including salaries, 52 opposed. It was pointed out that listing teaching positions in the Journal might bring into the teaching profession some capable persons from industry, thus reversing the flow of teachers into industry which is now taking place.

The General Council voted that advertisements of teaching positions be included in the JOURNAL for a trial period of one year; that no advertisements of individuals seeking positions be included; that no salaries be included in such advertisements; and that this opportunity be extended only to schools which are either Active or Affiliate Institutional members of the A.S.E.E.

*Plans for Annual Meeting at the University of Florida*

The Executive Board recommendation that the general sessions of the Society be devoted to subjects of widespread, vital interest to the Society membership and include nationality ETAOINETA and include nationally prominent speakers was presented. It was suggested that committee reports might be referred to other portions of the Annual Meeting program.

The possibility of devoting a General Session of the Society to a discussion of Society business and a presentation of reports on important developments was discussed. No action was taken, although it was recognized that such a general session, if included, should be carefully planned in advance.

*Free Distribution of Journals to Foreign Countries*

A suggestion that copies of the JOURNAL OF ENGINEERING EDUCATION be sent to libraries of European countries in order to gain more widespread recognition of the Society in foreign countries was discussed. It was suggested that 17 copies be sent to Great Britain, 1 to Holland, 1 each to the Scandinavian countries, and 8 or 10 copies to France. It was also suggested that a letter explaining the distribution be sent to each recipient institution.

The General Council voted to distribute 50 free copies monthly for a trial period of one year to foreign countries.

*A.S.E.E. Emblem*

Dean Freund presented three designs for the A.S.E.E. emblem, suggested by Profesor Blakesly of the University of Detroit's Architectural Department. These were slight modifications of a previous design tentatively adopted by the Council. The Council voted to adopt one of the designs submitted.

*Life Membership*

The General Council voted to grant the following persons life membership in the Society:

1. G. M. Butler
2. T. E. Butterfield
3. W. L. DeBaufre
4. E. P. Lambe
5. W. H. Martin
6. H. H. Metzenheim
7. C. J. Starr
8. J. S. Thompson
9. C. W. Tudbury

Respectfully submitted,
ARTHUR B. BRONWELL,
*Secretary*

# Report of Committee on Salaries, Southeastern Section*

*Preface*

This project is the result of feeling on the part of some of the members of the Southeastern Section that a current survey of salary information in engineering schools is desirable and necessary at this time. The last available and reliable information with regard to teachers' salaries in engineering schools for this region is to be found in the report of the Committee on Faculty Salaries of the Engineering College Administrative Council of the American Society for Engineering Education which was released in June 1949 and covered in general the academic year of 1948 through 1949. Without question, a great deal has happened which has had a tremendous impact upon engineering education since that date. The committee hopes that the facts and indications found herein will be of value to the administrations. It also hopes that the trends found in this study will be useful to stimulate a development which is long overdue in the engineering profession. The engineer who feels an obligation to his profession and assists in the training of future engineers has been forced for much too long a time to sacrifice the comfort and sometimes even the health of himself and his family in order to accomplish his purpose.

The committee is convinced that there is little incentive today capable of attracting excellent young men to the teaching profession if they aspire to the responsibilities of the upper academic ranks. The committee also feels that there is solid evidence in the report of a very dangerous trend which the popular writers might call "creeping socialism."

The most socialistic aspect of the general situation is the tendency to diminish continually the range of compensation between the lower and the higher grades in the teaching profession. In some instances, it has already resulted in competent, forceful, and ambitious young engineering teachers leaving the profession because they cannot conceive of their continuance therein holding any real promise. The decentive characteristic of all but a few of the rate structures surveyed in this report is almost appalling. The committee calls attention to this problem with real and sincere hope that the trend can be and will be reversed. It feels that it is second only in seriousness to the general situation of the appalling low, non-competitive rate structures available to attract competent, sincere and forceful young men into engineering teaching. Recently an ex-governor and prominent president of one of our southern universities made a very astute observation when he said that if the situation with regard to faculty salaries continues much longer, only the aged, the incompetent and the loyal will remain to teach the coming generations. Such a condition can lead only to a decline in the standards and excellence of the engineering staffs, which in turn will inevitably lead to a decline in the standards and excellence of engineering instruction, and thus in a short time to a decline in the competence and ethics of the engineering graduates and the professional engineers of the future. This our nation cannot afford nor endure.

*Introduction*

The committee sent out survey forms to accumulate data with regard to the salary ranges, the number of staff members, sum-

* Southeastern Section, Reported at the Clemson Meeting, April 12, 1952.

mer session salaries, and gains and losses of staff members for the academic years 1950–51 and 1951–52 to all twenty-four of the engineering schools in the southeastern region. The twenty-one schools which responded are listed below:

Alabama Polytechnic Institute
University of Alabama
University of Florida
University of Kentucky
Louisiana Polytechnic Institute
Southwestern Louisiana Institute
Louisiana State University
University of Mississippi
Duke University
North Carolina State College
University of Louisville
Clemson College
The Citadel
Tennessee Polytechnic Institute
University of South Carolina
University of Tennessee
Vanderbilt University
Virginia Military Institute
Virginia Polytechnic Institute
University of Virginia
University of Miami

Since the committee felt that this survey had three analytical objectives; i.e., the analysis of rate structures, the analysis of summer school salaries, and the analysis of quits and layoffs; the data as received was accumulated into tables to reflect these facts. These tables were set up to show a comparison between data pertaining to the academic year 1950–51 and the academic year 1951–52. Because of some of the inherent deficiences in the data, it was impossible to set up the data in the same manner as the 1949 ASEE report on teachers' salaries. The 1949 report was able to report medians because individual data with regard to salaries and other forms of compensation was obtainable. Neither time nor funds were available to obtain such detailed data for this current regional survey. The committee felt that the presentation of weighted averages and simple arithmetic averages, though leading to some error, would be sufficiently useful for comparisons.

### *Rate Structure*

A condensation of the detailed data received in this survey is presented in Tables A and B and Charts A and B. An attempt was made to indicate the relative pay status by the usual grades.

TABLE A

RATE STRUCTURE—ACADEMIC YEAR (10 MONTHS)

| Grade | Year | Minimums of Ranges | | | Average Salary Paid | Maximums of Ranges | | |
|---|---|---|---|---|---|---|---|---|
| | | Min. | Ave. | Max. | | Min. | Ave. | Max. |
| | | $ | $ | $ | $ | $ | $ | $ |
| Instructor | 1950–51 | 2300 | 2720 | 3120 | 3151 | 3020 | 3441 | 4000 |
| | 1951–52 | 2500 | 3077 | 3500 | 3427 | 3120 | 3336 | 4180 |
| Asst. Prof. | 1950–51 | 2960 | 3367 | 4000 | 3784 | 3040 | 4014 | 4800 |
| | 1951–52 | 3289 | 3693 | 4200 | 4094 | 3600 | 4290 | 5000 |
| Assoc. Prof. | 1950–51 | 3280 | 4023 | 4800 | 4573 | 3680 | 4801 | 6000 |
| | 1951–52 | 3440 | 4281 | 5000 | 4749 | 3760 | 5062 | 6000 |
| Professor | 1950–51 | 3920 | 4914 | 6000 | 5647 | 4320 | 5606 | 7500 |
| | 1951–52 | 4264 | 5212 | 6000 | 5980 | 4784 | 6180 | 8348 |
| Dept. Head[1] | 1950–51 | 3800 | 5176 | 6960 | 5670 | 4270 | 6047 | 7500 |
| | 1951–52 | 4770 | 5547 | 7332 | 5715 | 5050 | 6346 | 7932 |

TABLE B

RATE STRUCTURE—12 MONTHS PAY BASIS

| Grade | Year | Minimums of Ranges | | | Average Salary Paid | Maximums of Ranges | | |
|---|---|---|---|---|---|---|---|---|
| | | Min. | Ave. | Max. | | Min. | Ave. | Max. |
| | | $ | $ | $ | $ | $ | $ | $ |
| Instructor | 1950–51 | 3000 | 3317 | 3800 | 3739 | 3688 | 4028 | 4500 |
| | 1951–52 | 3444 | 3746 | 3888 | 4148 | 4104 | 4432 | 5300 |
| Asst. Prof. | 1950–51 | 3700 | 3969 | 4320 | 4614 | 3800 | 4852 | 5700 |
| | 1951–52 | 3850 | 4271 | 4900 | 5055 | 4500 | 5043 | 5600 |
| Assoc. Prof. | 1950–51 | 4100 | 4414 | 4800 | 5354 | 4600 | 5517 | 6600 |
| | 1951–52 | 4300 | 4599 | 4800 | 5655 | 4700 | 5601 | 6800 |
| Professor | 1950–51 | 4900 | 5552 | 5916 | 6183 | 5400 | 6821 | 8100 |
| | 1951–52 | 5200 | 5862 | 6300 | 6592 | 5600 | 6938 | 9000 |
| Dept. Head[1] | 1950–51 | 4600 | 5829 | 8000 | 6839 | 5400 | 7397 | 9500 |
| | 1051–52 | 4700 | 6301 | 8372 | 6991 | 5600 | 7663 | 9872 |
| Dean[2] | 1950–51 | 6677 | 7238 | 7536 | 7801 | 5800 | 7927 | 11,500 |
| | 1951–52 | 7039 | 7270 | 7500 | 8266 | 6000 | 8393 | 11,896 |

[1] Include some at associate professor rank, but most at professor rank.

[2] Range data (minimums and maximums) not fully reported, therefore may not be significant. Average salary paid based upon complete data.

The 1949 ASEE survey presented all of the data on an academic year payment basis. This common denominator was not selected for the current survey. It was the feeling of the committee that there is significance in the number of schools which employ and pay their staff on a 12 months basis. For this reason this data was accumulated and is presented in detail without change in the basis of payment.

An attempt was made in Tables A and B to analyze the rate range by grade and average salaries by grade. An attempt was also made to compare the minima and maxima to a scale recommended by the National Society of Professional Engineers and the American Society of Civil Engineers in 1946–47 for the payment of engineering teachers' salaries. This information is presented graphically in Charts A and B.

Charts A and B provide a shameful comparison to attainment of a recommendation made five years ago. They also reveal the extremely unfortunate decentive situation which exists in the rate structure of the colleges of this region. With so little to look forward to, it is difficult to understand why or how the administrations of the colleges herein represented can expect to obtain the type of young engineer that the profession demands for its engineering staff members. Without comparison to the salaries obtainable in industrial situations, but merely by the analysis of what the future holds in terms of engineering education, these charts present little in the way of an incentive. More important, they reveal what must be a firm belief in the minds of the administrative personnel who are responsible for the establishment of rate structure that experience means little in engineering education. If this were not so, why else would the relationship between the lower ranks and the higher ranks be so close and offer so little incentive for the assumption of the obligations which are inherent in the

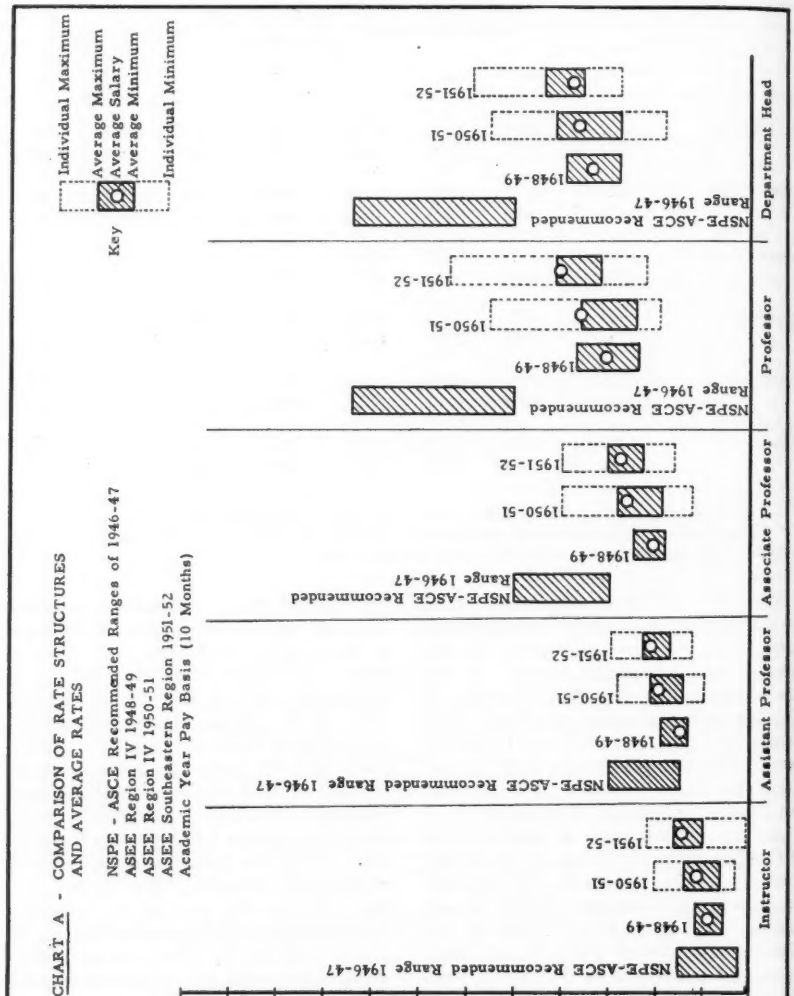
CHART A - COMPARISON OF RATE STRUCTURES AND AVERAGE RATES
NSPE - ASCE Recommended Ranges of 1946-47
ASEE Region IV 1948-49
ASEE Region IV 1950-51
ASEE Southeastern Region 1951-52
Academic Year Pay Basis (10 Months)
Key
Individual Maximum
Average Maximum
Average Salary
Average Minimum
Individual Minimum
Annual Salary (Academic Year Pay Basis) Thousands of Dollars
2
3
4
5
6
7
8
9
10
11
12
13
14
Instructor
Assistant Professor
Associate Professor
Professor
Department Head
NSPE-ASCE Recommended Range 1946-47
1948-49
1950-51
1951-52

CHART B - COMPARISON OF RATE STRUCTURES AND AVERAGE RATES
NSPE-ASCE Recommended Ranges of 1946-47
ASEE Region IV 1948-49
ASEE Region IV 1950-51
ASEE Southeastern Region 1951-52
12 Months Pay Basis
Key
Individual Maximum
Average Maximum
Average Salary
Average Minimum
Individual Minimum
Annual Salary (12 Months Pay Basis) Thousands of Dollars
2
3
4
5
6
7
8
9
10
11
12
13
14
Instructor
Assistant Professor
Associate Professor
Professor
Department Head
NSPE-ASCE Recommended Ranges 1946-47
1948-49
1950-51
1951-52

higher ranks? These charts and tables also reveal a very definite tendency, which the committee feels to be a dangerous one, to increase the rate structures in the lower scale without corresponding increases in the upper parts of the scale. This is ruining an already tragically poor rate structure.

*Summer Sessions*

Generally the engineering teacher must support his family on his academic year salary for a full fifty-two week year. Only a small percentage of those employed in teaching are able to increase their net income. Summer school teaching is not available for all, nor is the time during the summer session of sufficient duration to make for profitable employment in industrial situations. In many instances, summer positions require living away from home, and this added expense greatly decreases the net gain resulting from such employment. The older, more experienced faculty member with industrial contacts, prestige and standing is sometimes able to increase his annual income to an appreciable extent through consulting or other industrial employment during the summer. The men of lesser experience, however, do not have this opportunity. In addition to this, it must be recognized that seniority and rank in general have an important effect upon determination of who is employed for teaching in the summer sessions.

Analysis of the data was made with reference to pay during the regular term and for the summer session. The data showed wide variations and indicated that:

(a) The length of summer term varied from 6 to 12 weeks
(b) The weekly summer school pay varied from 60% to 115% of weekly academic year pay based upon a 36 week schedule.

In order to obtain the weekly pay for those on a 12 month basis, the average salary was divided by 46. The committee recognizes that there is no magic in the number 46; however, it is admitted and seems to be the most common practice that about six weeks of vacation are allowed to those members of the staff who are employed for the full 12 months basis. While a 46 week base year may seem to embody within it an exceedingly long vacation period or an excessive amount of free time in comparison to industrial situations, some thought should be given to this before such comparisons are made. The usual industrial concern allows a minimum of two weeks of vacation per year for all salaried employees and it is becoming even more common practice to allow an additional week or two for more than ten to twenty-five years of service. Furthermore, the usual industrial practice requires a five day work week and allows six to eight holidays per year. A comparison of free time is tabulated below:

COMPARISON OF "FREE TIME"

| | Industry | College (12 mo. pay basis) |
|---|---|---|
| Vacation | 14 days | 42 days |
| Saturdays | 50 days | 23 days |
| Sundays | 50 days | 46 days |
| Holidays | 7 days | 3 days |
| | 121 days | 114 days |

This table indicates that engineers in industry have about one week's more free time. The committee believes that this analysis is a realistic one.

The academic year salary was reduced to a weekly salary by dividing by 36 weeks. It is recognized that a 36 week year is not exactly realistic, as those serving on an academic year basis do have additional weeks of required work and do put in more time than this during the school year. The 36 week period was adopted, however, as representing two usual 18 week semesters or three 12 week quarters and thus representing the actual teaching time. This made it possible then to divide the summer salary by the number of the weeks of summer session and arrive at a comparable salary figure. It is recognized that the summer session will require some additional time above and beyond the actual weeks of teaching called

for during the period, so that the comparison is not too unrealistic when compared to the full forty-six week year, or the academic year of 36 weeks.

Although considerable discussion has already been presented with regard to the treatment of this data, it is believed that some comment is necessary with regard to the extreme lack of uniformity of payment. It seems that college administrators in reviewing this material might do well to give some thought to some uniformity of payment to their staffs for their services. Attention is called to the numerous instances wherein the difference in payment for the service during the academic year varies to a great extent, both higher and lower, from the payment for the summer session.

### *Analysis of Distribution by Academic Rank*

The committee felt that it would be interesting to analyze changes in the distribution of staff members within the region by academic rank for the two years under survey, and to make a comparison with the distribution of staff members found in the ASEE report of 1948–49. Because there was no significance in the distribution of deans, this data was omitted. This analysis is presented in Chart C, Distribution of Staff by Academic Rank. A careful analysis reveals two apparent tendencies. (1) Because of declining enrollment, there was a decrease in staff from 1950–51 to 1951–52. It is apparent that most of the change or reduction took place in the two lowest ranks. (2) It is also apparent by inspection that there was an increase in promotions to the higher ranks, particularly to the associate professorship rank over the two year period. It is thought that these two occurrences may bear some relation to a single cause.

The abnormal demand for engineers and engineering brainpower definitely led to a movement on the part of many of the younger staff members to go into industrial practice and receive an income which would allow them to supply their families with more of the needs and perhaps even a few of the luxuries of our civilization for which they were making contributions through their professional skill. It is believed with some reason that many of the schools resisted the loss of these men by promotions at a time in advance of that which would normally be expected. This has resulted in an increase in the number of associate professors in the 1951–52 year over the 1950–51 year, even though there was a reduction of 181 staff members in the region.

An interesting comparison can be drawn to the distribution in this region, both in 1948–49 and in the past two years, to the overall distribution by rank throughout the entire coverage of the 1949 survey. The southeastern region, even in 1948 and 1949, showed a tremendously heavier concentration of staff members in the lower ranks than in the nation as a whole. The recent reduction in the lower ranks tends to put this region more nearly in line with what would appear to be the usual distribution of staff by rank throughout the country.

### *Staff Turnover*

An analysis was made of quits and layoffs in the various schools in the region which submitted data. As this data was accumulated, deans and assistant instructors were excluded from the analysis because of lack of significance in the data available. This data was accumulated by colleges, and reveals that there was an important increase in quits from the year 1950–51 to 1951–52. The quit rate increased from 8.0 to 13.0. Some schools had no separations whereas others suffered a 29.3% loss. Some correlation between the wage scale of the colleges and their quit ratio was evident. The eighty quits over the two year period averaged $1,696.70 estimated increase per year. This covers all ranks and quits to change to industry and other teaching positions. The minimum reported increase was $600.00. The maximum reported increase was $5600.00. The data was not heavy enough to analyze by year, or by rank, or by rea-

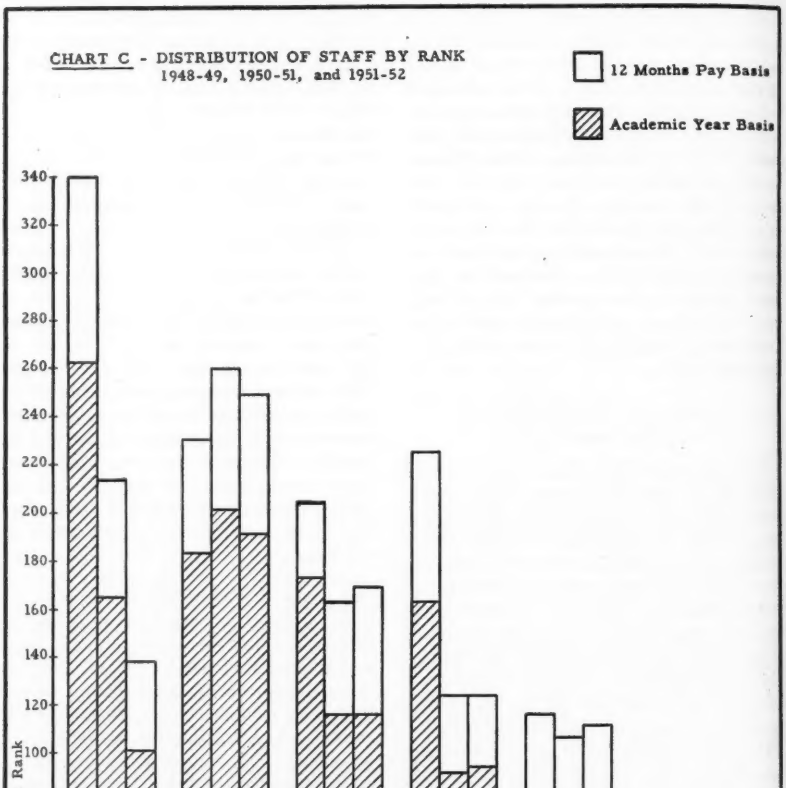
CHART C - DISTRIBUTION OF STAFF BY RANK
1948-49, 1950-51, and 1951-52
12 Months Pay Basis
Academic Year Basis
Number of Staff in Each Rank
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
1948-49
1950-51
1951-52
Instructors
Assistant Professors
Associate Professors
Professors
Department Heads
No data 1948-49
1950-51
1951-52
Deans

son for quit. Most reasons given for quits were financial.

An attempt was made in this survey to find out why the quits were occurring and if the primary cause has been for more money, just how much or even approximately how much of an increase in salary was being received by the persons who left the academic atmosphere for industry, or changed the atmosphere to another institution. Unfortunately, many of the deans reporting this did not have sufficient data on hand to make an individual college by college analysis possible nor an analysis by ranks. The majority of the quits was caused by a desire for more money. Interestingly enough, the detailed returns revealed that when a staff member quit to go to another college, his increase in salary was approximately the same or at least within the range of the middle fifty per cent of the increases received in the transfer of college staff members to an industrial atmosphere. There was, furthermore, no significant difference in the amount of money received for leaving the academic field in the 1950–51 period as compared to the 1951–52 period. While the quits over the two year period averaged some $1700 per year increase, a comparison of salary opportunities and salary structures in other branches of the engineering profession will show how easy it is to obtain this increase in annual income by an engineer who desires to leave the academic atmosphere.

### *Comments and Comparisons*

Two brief comparisons were attempted, one with salary opportunities in fields of engineering other than teaching, the other in comparison to another profession.

### *Comparison of Median Salaries of Engineering Teachers in Region IV with Average Net Income of Physicians*

Mr. William Weinfeld of the United States Department of Commerce made an exhaustive survey of the income of physicians during 1929 to 1949. This was reported in the publication, Survey of Current Business, published under the auspices of the United States Department of Commerce. Information from this study is presented below in comparison to median salaries obtained from the ASEE survey of teachers' salaries previously noted which were adjusted for a 12 months base by adding twenty percent. Salaries were compared in terms of average age in order to obtain a comparison with the information in the U. S. Department of Commerce publication of physicians income. The median salary of instructors is tabulated with the average age of instructors as opposed to the income of the same aged group from the aforementioned publication. This data is presented in summary form below.

While it is admitted that the physician spent more time in education before starting his period of earning in the past, the recent growth of graduate work and emphasis on doctorate degrees and experience in the higher ranks of engineering faculty members is closing this breech. It is hard to conceive that the disparity in incomes revealed by this comparison is commensurate with either the responsibility or the required education of the two professions, and again it becomes most evident that the decentive characteristic

| | Median Salary[1] | Average Age[2] | Average Net Income of Physicians[3] | |
|---|---|---|---|---|
| | | | Age Group | Net Income |
| Instructor | $3360 | 30 | 30–34 | $ 9,806 |
| Asst. Prof. | 4080 | 36 | 35–39 | 12,608 |
| Assoc. Prof. | 4920 | 44 | 40–44 | 14,476 |
| Professor | 6120 | 49 | 45–49 | 14,967 |
| Dept. Head | 6360 | 55 | 55–59 | 13,226 |

[1] From ASEE Survey of Teachers' Salaries in Engineering Schools, Region IV, 1948–49, adjusted for 12 months base by adding 20 per cent.

[2] Estimated from data in ASEE survey of teachers' salaries in engineering schools, Region IV, 1948–49.

[3] Source—Table 16, page 22, "Income of physicians" by William Weinfeld, U. S. Department of Commerce.

of wage advancement in the engineering teaching field is an important and frightening problem at the moment and one to which attention must be paid.

*Comparison of Engineering Teaching Salaries in the Southeastern Region with Salaries in Civil Engineering*

The August 1951 issue of *Civil Engineering,* published by the American Society of Civil Engineers, contains its annual survey of salaries for the civil engineering profession. In this issue an analysis is made of salaries paid under different conditions to professional personnel performing civil engineering functions. An abstract of this data is presented in Table C which compares average salaries determined from this survey for the 1951–52 period for instructors, assistant professors, associate professors, professors and department heads combined, and deans with a corresponding pay grade in the civil engineering survey. Salaries are reported in the civil engineering survey for 40 consulting firms covering 1886 engineers, 19 construction firms covering 2194 engineers, 70 private organizations reporting 5526 engineers, 22 state highway departments reporting salaries of 14,927 engineers, 21 municipalities reporting salaries of 1935 engineers and 50 public organizations such as county, regional, and large federal authorities reporting the salaries of 18,045 engineers. A further comparison is made to the recommended ranges for engineering teaching profession which have been published by the American Society of Civil Engineers and have been endorsed by the National Society of Professional Engineers. The recommendations were made in 1946 and so for purposes of comparison were adjusted upward by 25% to reflect the approximate change in the cost of living since the time of the recommendation.

A study of Table C is almost frightening in terms of the probability of obtaining competent, young engineering personnel in the engineering teaching profession. It is apparent that if the young engineer is not concerned with "security" and is more concerned with "opportunity," he will point his future towards the possibility of entering the consulting field. If, on the other hand, he is looking for and is interested in "security," he will have more interest in state highway departments, municipalities, and the public organizations. The socialistic or leveling tendency in the rate structure is apparent as we move from the more competitive situations to the more restrictive situations which are controlled by or are paid through taxation or public moneys. It is apparent that the longer one works for the public, the lower such experience and professional development is valued.

*Engineering Education Salaries vs. Engineering Industrial Salaries*

Another simple comparison which can be made is the comparison between the beginning salary of the recent engineering graduate should he be hired by private industry or by the colleges.

Let it be said, and let it be recognized but not disputed, that the type of individual sought for engineering teaching is the same type of individual sought by the best private employers. The young man desired by the private employer is a graduate in the upper third of his class, articulate, reasonably mature, who has given evidence of leadership and the ability to command the respect of others. This same type of man is what the engineering teaching profession needs. Private employers are offering young men of this caliber an entering salary of $325 per month to $350 per month. This same young man, should he seek to enter the teaching profession, would be forced, as this survey reveals, to accept a starting salary not much in excess of $250 per month. Obviously, engineering colleges cannot hope to interest a sufficient number of young men, or the proper type, in engineering teaching if this condition is to exist. On the other hand, if the college administrations seek even to approximate a competitive salary scale with industry, they would have to pay what would approximate the entering sal-

## TABLE C

COMPARISON OF RATE STRUCTURE OF ENGINEERING TEACHING POSITIONS IN SOUTHEASTERN REGION ASEE WITH SALARIES OF CIVIL ENGINEERING POSITIONS AND RECOMMENDED SALARY RANGES FOR ENGINEERING TEACHING POSITIONS

ANNUAL SALARIES

| ASCE Grade | Equivalent Rank | ASEE[1] 1951–52 Survey | | ASCE 1951 Survey[2] | | | | | | | | | | | | ASCE[3] Recommended Ranges for Engr. Teaching | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Consulting Firm | | Construction | | Private Organization | | State Highway Depts. | | Municipalities | | Public Organization | | | |
| | | Ave. | Ave. | | | | | | | | | | | | | | |
| | | Min. $ | Max. $ | Min. $ | Max. $ | Min. $ | Max. $ | Min. $ | Max. $ | Min. $ | Max. $ | Min. $ | Max. $ | Min. $ | Max. $ | Min. $ | Max. $ |
| 1–2 | Instructor | 3020 | 3636 | 3100 | 3900 | 3380 | 4050 | 3100 | 3921 | 2725 | 3330 | 3180 | 3860 | 3005 | 3655 | 3380 | 5250 |
| 3–4 | Asst. Prof. | 3693 | 4290 | 4600 | 5400 | 5000 | 6000 | 4690 | 5400 | 3980 | 4590 | 4288 | 4900 | 4250 | 4910 | 5250 | 7650 |
| 5–6 | Assoc. Prof. | 4281 | 5062 | 6340 | 7500 | 6820 | 7510 | 6370 | 7350 | 5540 | 6265 | 5100 | 6300 | 5590 | 6470 | 7650 | 10,750 |
| 7–8 | Prof. and Dept. Heads | 5212 | 6346 | 8800 | 10,500 | 8735 | 9800 | 8810 | 10,000 | 7200 | 7700 | 6730 | 7900 | 7200 | 7945 | 10,750 | 15,750 |
| 9 | Dean | — | — | 11,325 | 22,000 | 12,000 | 15,550 | 11,450 | 17,400 | 7735 | 9990 | 6680 | 12,800 | 7980 | 12,300 | 15,750 | up |

[1] Source—Average minimum and average maximum of schools reporting in Southeastern Region—1951–52 scales on a 10 months basis.

[2] Source—"Survey of Salaries for Civil Engineering Positions"—*Civil Engineering*, August, 1951—Tables III and IV. Minimum of range selected as entrance rate median of lower grade of ASCE grade; maximum of range selected as entrance rate median of higher ASCE grade for each level of teaching rank.

[3] Source—Report of ASCE recommending salary scales for engineering teachers—1946; adjusted upward 25% to reflect changes in cost of living since report.

ary for the associate professorship level, or would have to pay what an engineer of some 20 to 25 years of professional experience is getting if employed in the engineering teaching profession. The charts and tables already reviewed reveal the very severe decentive characteristics of the existing rate structure.

Obviously this characteristic of payment cannot continue, or it will not be possible to interest those capable young men now engaged in the teaching profession to continue in their chosen field.

Respectfully submitted,

PROF. FRANK F. GROSECLOSE
PROF. H. L. MANNING
PROF. LOUIS R. SHOBE
DR. W. P. WALLACE
DR. GORDON C. WILLIAMS
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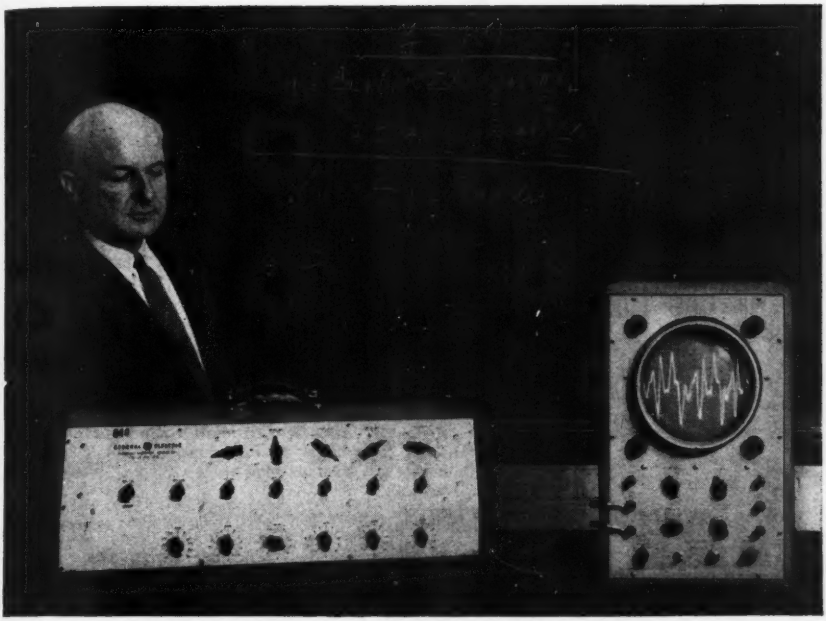

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